Engineering News-Record

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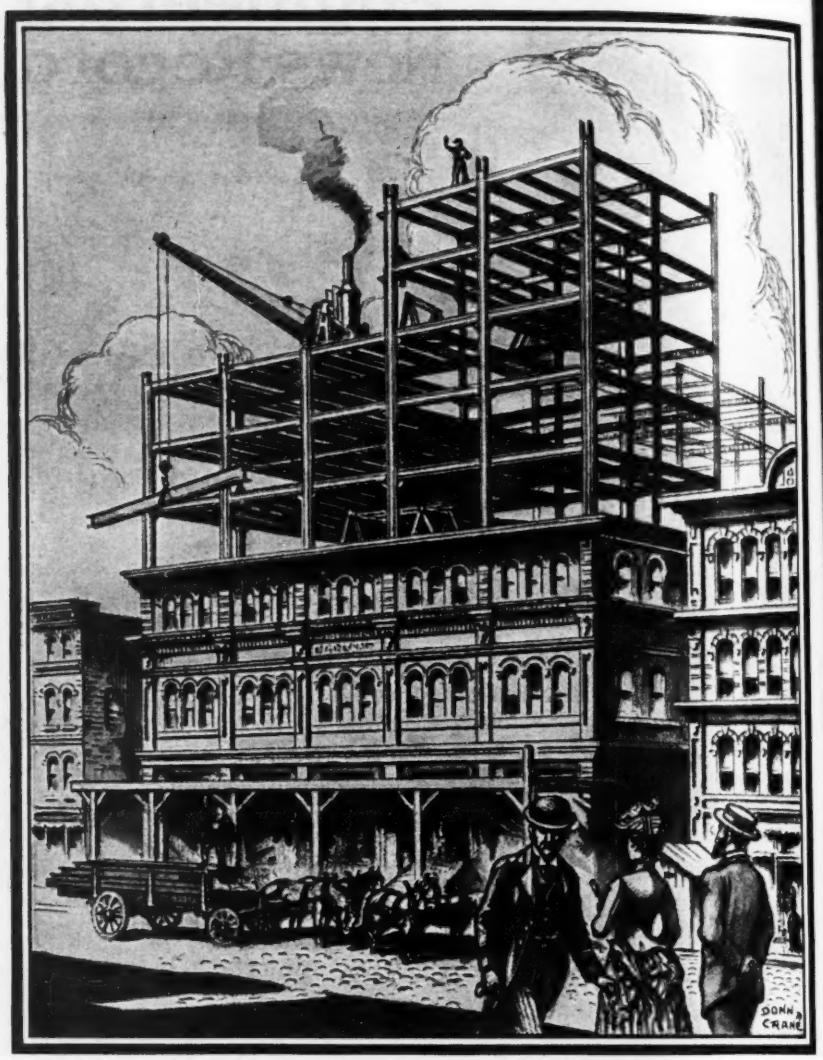
The First of The Moderns

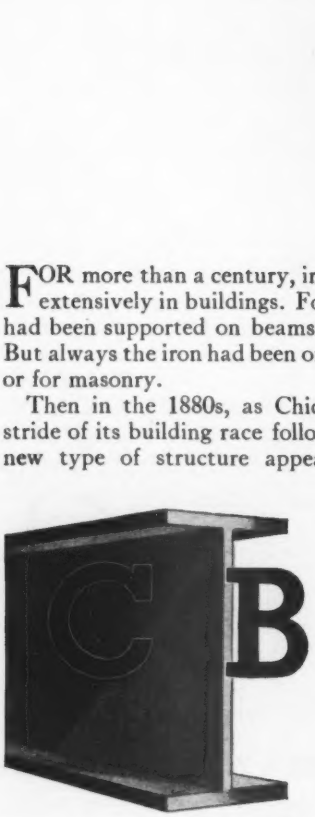


FOR more than a century, iron columns had been used extensively in buildings. For seventy-five years floors had been supported on beams of cast or wrought iron. But always the iron had been only a substitute for timber or for masonry.

Then in the 1880s, as Chicago swung into the full stride of its building race following its disastrous fire, a new type of structure appeared, a new and unique development in the use of steel construction.

These new buildings were the first to incorporate the principle of modern skyscraper construction: the use of a complete steel cage framework supporting all the weight of walls and floors.

A new era in building had dawned, though even the most enthusiastic supporters of the new style never dreamed of the development that subsequent decades were to witness.



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Engineering News-Record

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Belt Concreting at Wards Island

On new 180-m.g.d. sewage plant at New York a combination of fixed and portable belt-conveyor units has distributed 108,000 cu.yd. of concrete over an area of 30 acres—Heavy wall-form panels moved by special handling rig on truck

HEMMED IN on two sides by the high-level line of the New York Connecting Railroad and on the other two sides by the waters of Hell Gate and Little Hell Gate, the contractor on the Wards Island sewage-treatment plant in New York could not find room for the installation of the traveling cableway generally used on this type of work for handling concrete, reinforcing steel and forms. In the necessary departure from customary methods a combination of fixed and portable belt-conveyor units was finally adopted for the placing of 108,000 cu.yd. of concrete in thin wall sections and footings spread over an area of 30 acres. Agitator trucks, loaded at hoppers fed from the main belts, are used on the footing work, and also for carrying concrete to isolated conveyor units at outlying structures beyond the reach of the main distributing system.

The success of belt conveyors for concrete handling on this type of work is indicated by the progress made. Although four years' time was allowed for the completion of the contract, the concrete will all be placed within one year and the contract finished in eighteen months from the time of starting the excavation. From May until September a daily average of 800 cu.yd. of concrete was poured, and this output reached a peak of 1,100 cu.yd. per day in the latter part of July. Another important factor in the progress made was the use of heavy form panels handled by special rigs on trucks for forming curved walls in the aeration tanks, this type comprising the bulk of the wall work on the job.

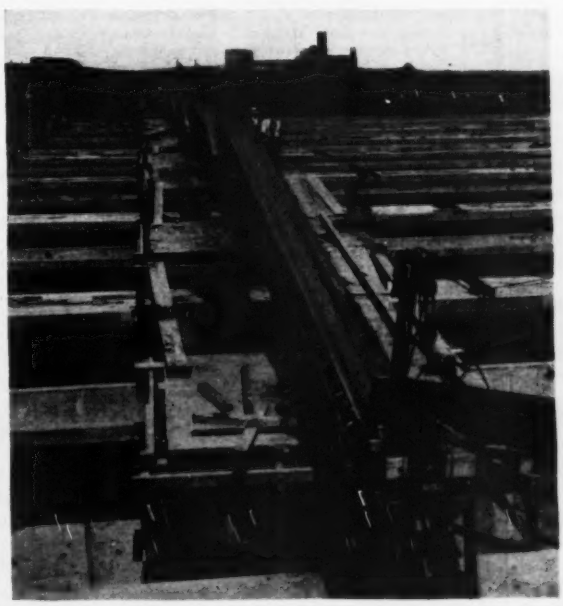
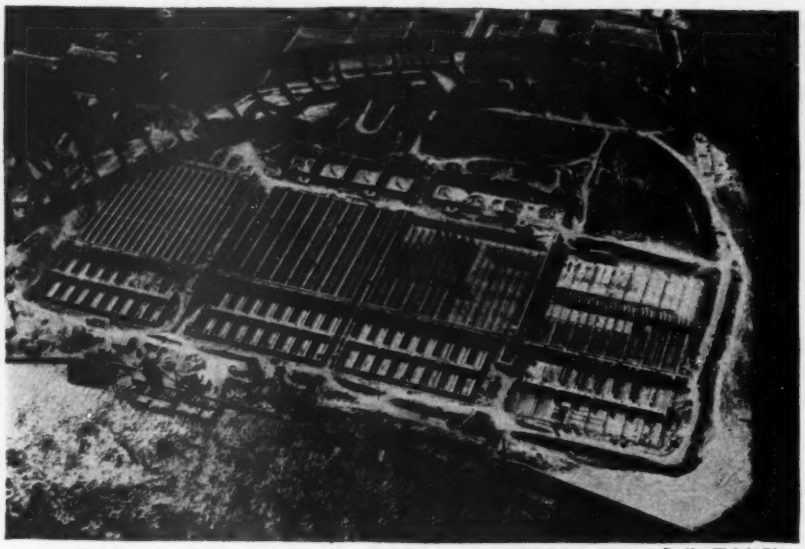


Fig. 1—Train of portable conveyors mounted on rolling towers distributes concrete for aeraton tank floors and walls for Wards Island activated-sludge plant in New York.

As the site of the work is an island accessible only by boat, delivery of all materials and equipment has to be made by water and at considerable extra cost, for the job location is outside the New York free lighterage limits. All operations of excavation, drainage, pipe laying and concrete work were carefully coordinated, resulting in prevention of delays and ultimate completion in advance of scheduled time. Difficulties were encountered in excavation, as the actual quantities of rock removed in foundations and trenches were found to be in excess of the engineer's estimate.

General design

The Wards Island activated-sludge plant, rated at 180-m.g.d. capacity, is the first of several sewage-treatment plants scheduled for construction in greater New York. It is located on the northeast corner of the island in the shadow of Hell Gate Bridge and will serve upper Manhattan and the lower Bronx. The present contract is only for the sewage-treatment tanks, including the piping and sludge equipment. Contracts have not yet been



Curtiss-Wright Photo

Fig. 2 — Belt-conveyor system distributes concrete for 30-acre Wards Island sewage-treatment works from central plant shown at riverfront in left foreground. Primary treatment tanks are under construction in background. Large basins in center, divided by multiple walls, are aeration tanks. Final treatment tanks are shown in foreground.

awarded for the main pump and blower plant, superstructures and other items of work on Wards Island, the intercepting sewers along the upper Manhattan and lower Bronx River fronts, and the subaqueous tunnels leading the sewage from these intercepters to Wards Island. The treatment plant, shown in Figs. 2 and 4, consists of eight preliminary tanks, roughly 99 ft. square with rounded corners; sixteen aeration tanks arranged in four basins of four tanks each, each tank containing four channels 22 ft. wide and 345 ft. long, with an effective depth of 15¼ ft.; and 32 final treatment tanks, 43x179 ft., arranged in four batteries of eight tanks each.

The aeration-tank walls, 17 ft. high, are curved outward at both top and bottom (Fig. 4) to produce a spiral motion in the flow of sewage as it is aerated. Carried by spread footings, these walls remain solid at the bottom but at the top are split by a V-shaped trough. Heavy division walls divide each basin into four tanks. Each tank is further divided into channels by one center wall and two intermediate walls, which act as baffles to guide the flow of the sewage during the period of aeration. The troughs in the intermediate walls carry the compressed-air lines for the aeration of the sewage and are covered with 4-in. precast slabs, which are removable to give access to the pipe work. The troughs in the other walls are covered with reinforced-concrete slabs 6 in. thick, cast in place. Air for the aeration process is carried from supply mains in the intermediate wall troughs to tank bottoms, and will be released through diffuser plates. These plates are held in precast concrete containers. A more detailed description of the plant was published in *ENR*, Dec. 26, 1929, p. 1005.

Preliminary construction

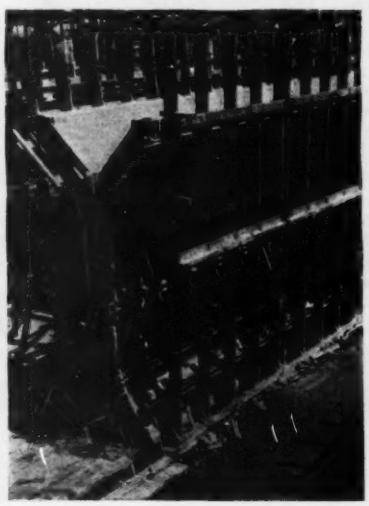
The ceremony of breaking ground was held on July 7, 1931. By the end of that year most of the general excavation had been completed, and the winter months were devoted to the installation of the underground pipe and concrete work. This permitted the site to be leveled up so that the bulk of the concrete operations could be pushed during the summer months of 1932 without interference. Concrete for work done during the winter was mixed at a temporary batching plant on the waterfront and was transported to the point of deposit by agitator trucks, to be placed, as a rule, by portable belt conveyors operated by gas engines.

Excavation of the site required the removal of about 400,000 cu.yd. of material, of which 72,000 cu.yd. was rock. Power shovels, cranes, tractors and trucks were used for this operation, the excess spoil being principally disposed of in extending the north and east shore lines of the site. A sufficient quantity of excavated earth was placed in storage for backfilling around the completed structures. All concrete work rests either on original soil or on a minimum of compacted earth placed over rock.

Following the general excavation work, trenches were dug for the installation of cast-iron pipes, under-drains and concrete conduits connecting the various parts of the work.

The planning of the concrete-distributing system for the construction of the three classes of tanks constituted a major problem. There was nearly 100,000 cu.yd. of concrete remaining to be placed in a period of about six months. The design of the structure called for definite expansion joints, which limited the average pour to about 40 cu.yd. of concrete. The speed schedule set down for the job necessitated the deposit of as much as 800 cu.yd. of concrete a day, which meant that concrete had to be placed in about twenty different locations during the working day. This condition made necessary such a flexible system for distributing the concrete that the idea of a traveling cableway would probably have been discarded even had the surrounding encroachments upon the site permitted the installation of one. Furthermore, the contractor did not consider a single traveling cableway to be of sufficient capacity or flexible enough to place the required yardage of concrete over the widespread area of the plant layout within the scheduled time.

Fig. 3—Section of wall forms after trough forms had been stripped. Double angle along outside of studs provides means for handling heavy panels with specially fitted truck.



Concrete plant

The central concrete plant is located near the waterfront, as shown in Fig. 4. This plant contains two 1½-yd. mixers, fed by gravity through manually operated weighing batchers for fine and coarse aggregates, and an automatic weighing batcher for the cement, which was delivered in bulk. All these materials arrive alongside in barges. Cement is transferred from barge to operating bin above the mixers by air delivery. Sand and gravel are handled by a specially designed steel stiff-leg derrick from deck barges directly to bins above the mixer. Except for a small storage of materials in the operating bins above the mixers, the job depends entirely upon the storage of materials on the barges. This arrangement gives to the mixing plant a supply of aggregates only sufficient for about one hour's work and a cement supply sufficient for about three hours' work when the plant is running at full capacity. This condition requires that absolute dependence be placed upon the unloading rig for coarse and fine aggregates and upon the equipment for unloading cement. The con-

fidence placed by the contractor in these specially designed items of equipment was justified, as no delays have been caused to the job by their failure to operate properly.

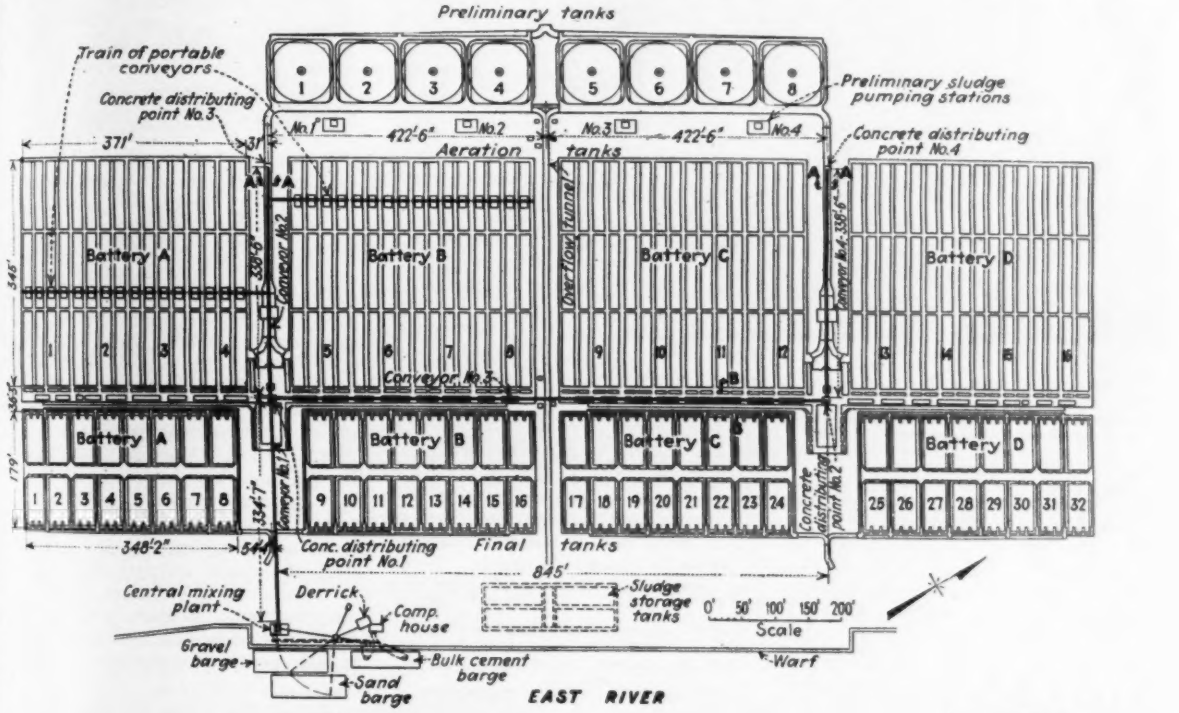
One set of batching equipment feeds both mixers. From the mixers concrete is discharged into a 5-yd. hopper, from which it is fed onto belt conveyor No. 1, running from the mixing plant to distributing station No. 1.

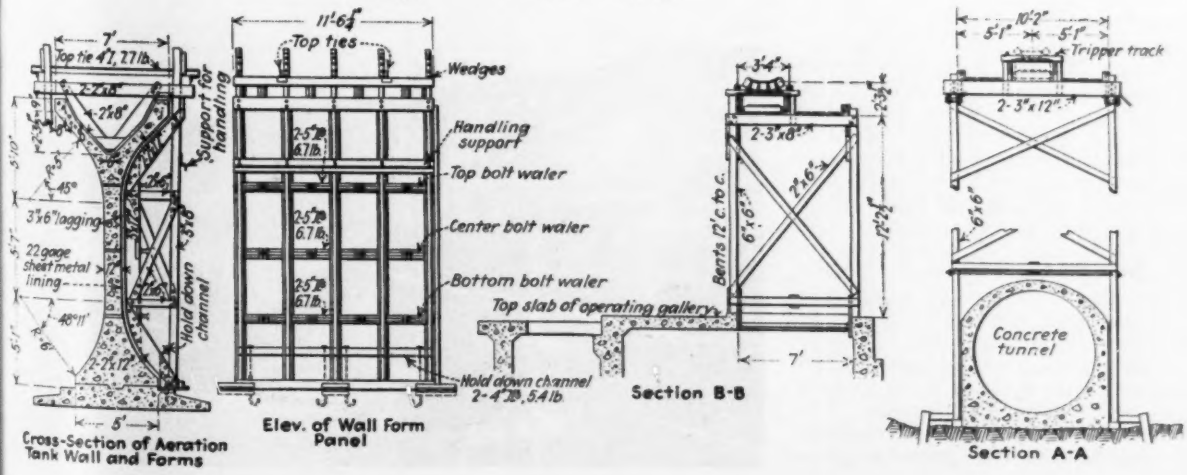
Concrete-distributing system

The general layout of the primary distributing system is shown in Fig. 4. From the mixing plant conveyor No. 1 carries the concrete up an incline to distributing station No. 1, a horizontal distance of 335 ft. with a rise of about 24 ft. From this station the concrete can be sent forward on conveyor No. 2, to the north on conveyor No. 3, or shunted into an 8-yd. hopper for the loading of agitator trucks, or the concrete can be split between conveyors No. 2 and No. 3 when the character of the work makes it impossible for a placing gang to handle the full output of the plant in one location. Conveyor No. 2 is 340 ft. long, and at its terminal point discharges into an 8-yd. hopper for the loading of agitator trucks. Conveyor No. 3 is 850 ft. long and carries the concrete to distributing point No. 2, from where concrete can be transferred to conveyor No. 4 or into an 8-yd. hopper for the loading of agitator trucks, or the flow can be split between the two outlets. Conveyor No. 4 is 340 ft. long, and at its terminal point there is another 8-yd. hopper for the loading of agitator trucks, thus giving four points on the job at widely separated locations for the economical loading of the trucks used on miscellaneous work, with the length of haul at a minimum.

These four main-line conveyors, aggregating 1,865 ft. in length, constitute the primary stage of distribution. They are equipped with 24-in. rubber belts of special design, all running at the same speed. Conveyors Nos. 2, 3 and 4 are equipped with rolling trippers, permitting concrete to be taken from these belts at any point throughout their length (Fig. 7). The trippers on conveyors Nos. 2 and 4 feed the concrete by gravity through a 40-ft. chute to the first unit of two trains of portable conveyors of eight units each, which handle practically all of the concrete in the slabs and walls of the four aeration batteries. A considerable quantity of concrete was deposited in final tanks *B* and *C* and a smaller amount in the easterly

Fig. 4 — General plan of Wards Island plant, showing location of concrete plant, main-line belts, supporting towers, concrete-distribution points and wall forms.





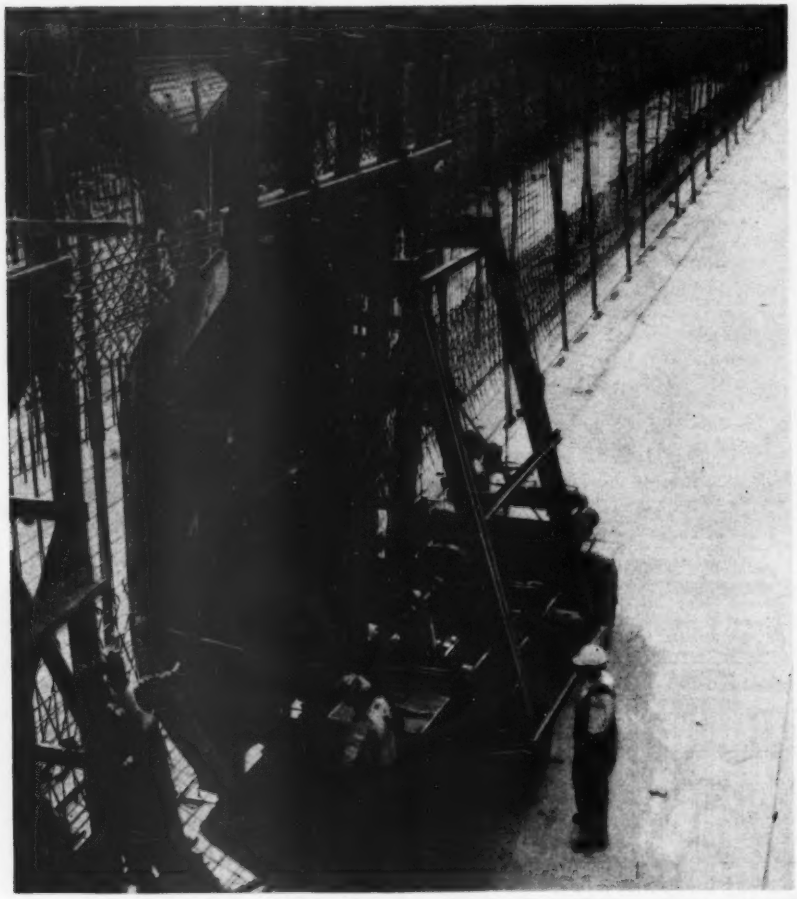


Fig. 5—Truck fitted with A-frames and winches handles, 6,000-lb. steel and timber form panels in aeration tanks. Truck operates on tank floor, short sections of walls being temporarily left out to permit passage from channel to channel.

end of aeration basins *B* and *C*, directly by chute from the tripper on belt No. 3.

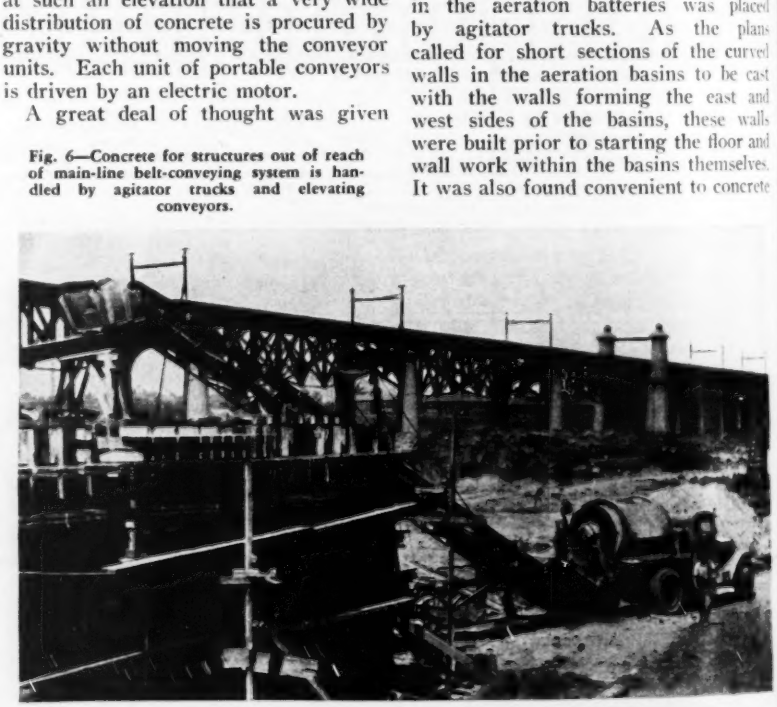
The final placing of the concrete in the aeration basins is by means of two trains of portable conveyors already mentioned, these working simultaneously in batteries adjacent to conveyors No. 2 and No. 4. In other words, basins *A* and *B* were constructed from conveyor No. 2, and then the two trains of portable conveyors were moved over into basins *C* and *D* to be fed from conveyor No. 4. These portable conveyor units are each 47 ft. in length, with their terminal points arranged to come over every second wall in the aeration basins. Each conveyor unit is carried on two portable timber towers rolling on the concrete tank floor. These towers (Figs. 4 and 8), equipped with 24-in. wheels, are 25 ft. high and are topped with 14x16-ft. decks. Bridges span between towers to give ample working space around all parts of the conveyors, the bridges being removable to permit one conveyor and its two supporting towers to be rolled forward in a unit as the work progresses. The conveyors are at a sufficient elevation to allow concrete to be poured by gravity from the terminal points on the individual conveyors directly into the walls. This arrangement also provides concrete for the floor work in the basins at such an elevation that a very wide distribution of concrete is procured by gravity without moving the conveyor units. Each unit of portable conveyors is driven by an electric motor.

A great deal of thought was given to the design of the chutes that led the concrete from the conveyors to the wall forms and floors, as the success of the operation depended upon a change from one pouring location to another with such rapidity that the delivery of concrete from the mixing plant was not interrupted. With a daily average of twenty pours in different locations, a delay of even a few minutes between these pours would cut seriously into the daily yardage placed. A specially trained gang had the sole responsibility of moving chutes for the concrete crew. The expense of using an aluminum alloy in the manufacture of the chutes, line gates, etc., was found to be a good investment, as the greatly reduced weight of these items necessitated only a small gang for this operation.

Sequence of operations

A careful study was necessary in planning the sequence of operations to assure no interruption in the progress of the work. As already stated, the winter months were principally devoted to the installation of the underground work, so that the site might be leveled up to permit pushing the work during the summer season. Certain other work also had to be completed before the concrete-distributing system could be installed. All concrete had to be in place in the main pump houses, as these structures were used to support distributing points Nos. 1 and 2. The operating gallery for basins *B* and *C* had to be finished to support conveyor No. 3; and the concrete conduits, 84 in. in diameter, with venturi chambers, etc., between batteries *A* and *B* and between *C* and *D*, had to be finished, as they lay directly under the trestles supporting conveyors Nos. 2 and 4. Concrete for all footings in the aeration batteries was placed by agitator trucks. As the plans called for short sections of the curved walls in the aeration basins to be cast with the walls forming the east and west sides of the basins, these walls were built prior to starting the floor and wall work within the basins themselves. It was also found convenient to concrete

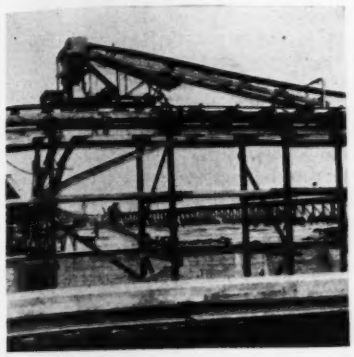
Fig. 6—Concrete for structures out of reach of main-line belt-conveying system is handled by agitator trucks and elevating conveyors.



a strip of floor along the west wall of the basins before putting the portable conveyor train in place, thus providing a smooth floor for the rolling towers.

The conveyor train is put in place on the strip of floor along the west wall and is moved gradually toward the east side of the basin as the sections of floor are concreted ahead. As soon as this operation is completed, the curved wall forms are started from the east

Fig. 7—Tripper transferring concrete from a main-line belt to a train of portable conveyors in aeration tanks.



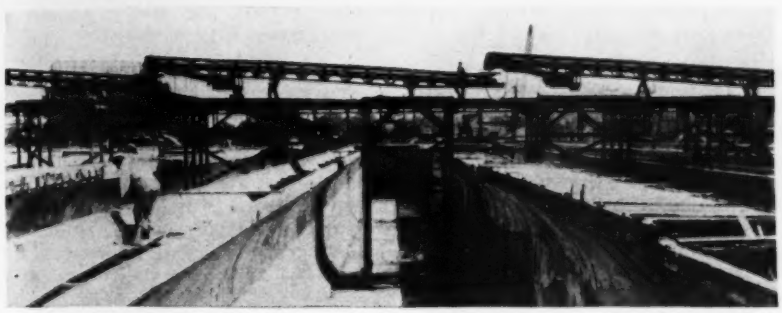


Fig. 8—Rolling towers connected by bridges carry train of portable conveyors for placing concrete in aeration tanks.

wall and moved westward, the train of conveyors following them as they progress. As a result of this procedure the conveyor train makes one trip from west to east concreting the floor slabs, and two trips from east to west concreting the walls of each basin. Before the conveyor train is removed from a basin all cast-in-place slabs covering the troughs in walls are poured, as no miscellaneous work is permitted to fall behind the general progress.

Interior wall forms of aeration basins

The forms for the walls within the aeration basins are very rigidly built, (Fig. 3). The form sections are full height of the wall and about 12 ft. in length, six sections being sufficient for a 68-ft. section of wall between expansion joints with sufficient lap on the wall already cast and room for the bulkhead at the forward end of the form. The form sections weigh about 6,000 lb. each and are easily moved by an elevating rig mounted on a 5-ton truck chassis. Except for the walls within the aeration basin, there is no case on the job where sufficient repetition without change occurs to warrant other than the lighter type of wood form made up in light panels, which are possible to alter without undue expense.

Handling reinforcing steel

The 6,500 tons of reinforcement is received by barge in lots of 400 to 500 tons. It is unloaded on bolsters at the wharf and at once transported by a gantry truck in 10-ton loads to points of use. Steel to be bent is transported in a similar manner to a power bending table, bent as required, repiled on bolsters and immediately taken to where it is to be placed. In assembling the steel in the walls concrete "doughnuts" strung on longitudinal bars were used as spacers to hold the steel away from the forms. Temporary wooden props were also required to keep the steel assembly erect until the forms could be set.

Precast concrete work

A small casting yard was established at the north end of the job for the manufacture of the precast slabs for the troughs in the intermediate walls of the aeration basins. This yard is controlled by a small gantry crane with electric hoist used for removal of slabs from the casting platform to the storage pile along side. Concrete for these slabs is transported by agitator truck from one of the delivery hoppers on the main distributing line and is placed directly in the forms from the truck by means of a chute equipped with line gates over the various casting points.

Pipe Work and Equipment—The installation of the great amount of complicated pipe work for both air and sewage, valves, sluice gates, meters, etc., as well as the sludge equipment in the preliminary and final tanks entering into the plant has been made to follow immediately behind the progress of the concrete work, and all of these miscellaneous items will be completed and ready for testing within one month after the last concrete is poured.

Personnel—The Wards Island sewage-treatment plant is being built by the city of New York, Department of Sanitation, Dr. William Schroeder, Jr., chairman, Leonard C. L. Smith engineer member, Richard H. Gould engineer, and A. R. Glock resident engineer. Fuller & McClintock, of New York City, prepared the plans and specifications with Pearse, Greeley & Hansen, of Chicago, as associate engineers.

General contract for work described was let to W. H. Gahagan, Inc., of Brooklyn, N. Y., with Wm. Oberly general superintendent in the field. The Turner Construction Co., of New York, is subcontractor for all concrete work, and the operation of its work was planned by R. C. Wilson, vice-president, with G. F. Floyd general superintendent.

The Link Belt Co., of Chicago, has the subcontract for all equipment in the final tanks, and the Dorr Co., Inc., of New York, has the subcontract for all equipment in the preliminary tanks.

Accelerated Absorption Tests on Concrete

A method of using standard 6x12-in. cylinders in making accelerated absorption tests on concrete has been developed in connection with the construction of lock and dam No. 15 in the Mississippi River at Rock Island, Ill., now in progress.

The importance of imperviousness and compressive strength in concrete construction has long been recognized, although the former has not received as much attention as the latter. Concrete that is subject to intermittent immersion in water or to weather exposure depends for its durability upon the impervious quality as well as the compressive strength.

The usual absorption-test method has been accelerated by means of immersing the standard compression-test cylinder in a specially designed tank filled with water and by creating a pressure of 200 lb. per sq.in. during the test period.

After having passed the seven-day curing period, the test cylinders are weighed and oven-dried at a temperature of about 240 deg. F. for 24 hours. The cylinders are then weighed, cooled to room temperature, immersed in the tank and subjected to a pressure of 200 lb. per sq.in. for a period of four hours. The specimen is then removed from the tank and weighed again, and the percentage gain in weight is determined.

The results of this test indicate the porosity of the concrete as well as the ability to withstand alternate wetting and drying, conditions to be met under actual exposure on the job. Continued absorption tests carried on since June, 1931, show that a variation in imperviousness results from changes in the gradation of aggregates, the quantity of mixing water, the time of mixing, the use of admixtures, the method of placing and the curing. The test method was developed in the U. S. Engineer Office, Rock Island, Ill.

Good Practice in Outdoor-Sign Design

Safety demands conservative design with high assumed wind loads, low unit stresses and positive anchorage—Simple beams and hinged joints contribute to safety in case unsupervised alterations are made to the framework

By F. D. Hartford
Consulting Engineer, Denver, Colo.

BOTH city building ordinances and the advertising fraternity classify outdoor signs, other than those painted directly on walls, as ground signs, roof signs and projecting signs. The engineer designing or fabricating the steel for signs will divide them into "spectaculars" or those carrying special skeleton characters or ornaments (Fig. 1) and "posters," or the conventional solid sign or billboard (Fig. 2)

Loads on signs

The building ordinances covering signs in most cities and the model ordinance put forward by the National Board of Fire Underwriters specify that signs must be so constructed that they will safely withstand a wind pressure of 30 lb. per sq.ft. of area subject to such pressure. This pressure corresponds to a velocity of wind of about 86 miles per hour if no allowance for impact is made. However, the common experience of those working on signs is that high winds are pulsating in their action and set up vibrations or weaving in the sign frame. Accordingly, it will be better to consider that the 30-lb. pressure is made up of a uniform 20-lb. pressure (70 miles per hour) and a 10-lb., or 50 per cent, impact. The pressure specified by the building ordinances should be considered a minimum and should be suitably increased in exposed locations and where winds of high violence have occurred.

In addition to rapid positive pressure variations, many signs are so located that they are also subject to reversals of stress in the members of the frame. Roof signs in certain congested city locations may receive wind pressure from the front over part of the face and pressures from the rear on the remainder of the structure.

The conventional "24 sheet poster" or painted display sign is about 47 ft. long and 13 ft. high over the ornamental moldings. If there is a decorative lattice at the bottom or the ends, it too should be included in the exposed area. A lattice more than 50 per cent closed should be figured as solid.

Frames for spectaculars should be designed conservatively so far as the exposed area is concerned, since their characters or the backgrounds may be enlarged. Spectaculars are sometimes changed even into solid signs.

Stresses in sign steelwork

Building ordinances commonly specify that all roof and projecting sign frames be fireproof. Structural steel is the only material that can fulfill this requirement economically. Some sign companies have also found it cheaper to make the frames of their ground signs of steel in place of wood because of the mutilation and decay to which wood is subject.

Due to the general lightness possible with steel for sign frames, the writer believes it inadvisable to allow any continuity in either members or joints. Sign frames may be so altered by inadequately supervised sign company workmen that the designer should protect himself and his company by figuring all beams as simple and all joints as hinged. Because wind loads are pulsating, because frequent reversals of stress in the members occur, and because of the likelihood of corrosion the writer questions the advisability of taking advantage of specifications permitting members carrying wind stress only to be designed for 24,000 lb. per sq.in. in tension. Instead the usual 18,000 lb. per sq.in. in tension and the usual column formulas with a maximum l/r of 200 should be used.

Particular care should be taken to brace the flanges of beams against lateral deflection. If the length of the unbraced compression flange exceeds fifteen times the flange width, reduced stresses should be used. It should be recalled that on most sign frames either beam flange may be in compression, depending on the direction of the wind.

Since steel sign frames are usually field-bolted with unfinished bolts, some of which are certain to become loosened after a time, the stresses allowed for bolts should be conservative.

Fig. 1—Signs carrying special skeleton letters or ornaments and known as "spectaculars" are of large size and require unusually conservative design.

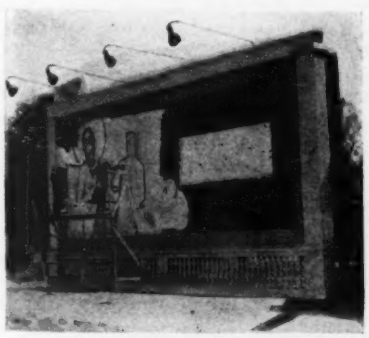


Fig. 2—The poster sign presents a solid face to the wind. Lattices more than 50 per cent closed should be figured as solid.

Sign anchorage

Many, perhaps a majority, of the failures of sign structures are due to defects in the anchorage of the sign frame to masonry walls. Thus the entire sign may be blown away bodily and wrecked against a building or the ground—a contingency which no amount of material in the frame itself could withstand.

Most building ordinances forbid attaching a steel sign frame to a wood roof in any way. They also provide that the anchorage must be carried well below the level where the roof joists enter the wall. Fig. 3 shows a typical anchorage of a truss that carries sign uprights. In particular it is to be noted that the angle anchor is of sufficient length to grip a considerable body of masonry and that it goes as far below the roof joists as possible to take advantage of a considerable amount of roof dead load.

Since the downward reaction of this sign truss is carried by a 9-in. parapet wall, the bearing plate is stiffened by a transverse angle to spread out the load suitably. If there is any considerable longitudinal force along the trusses or beams under the sign verticals, such as might be caused by a skewed sign face, then particular care is necessary to transmit this force into the body of the brickwork. When the sign is placed over a steel or concrete frame roof the anchorage problem is greatly simplified.

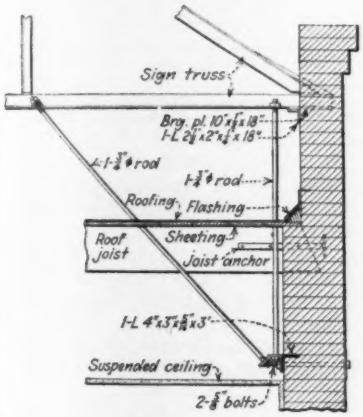
In connection with sign anchorage of all kinds two points should be carefully considered: first, any steel parts going

through the roofing should be so arranged that they may be easily and permanently waterproofed; second, no anchorage should penetrate into rooms which are tenanted or the walls of which are decorated.

The sign face

For spectaculars the advertising company furnishes a layout of the letters and decorations together with a detail showing their connection to the steelwork. The designer is then at liberty to arrange his girts in any manner to give the proper support. Poster and painted display signs, however, are different. Their faces are sheet steel that may be nailed directly to nailing strips bolted to the steel girts. The sign itself is then either pasted or painted on the sheet steel. The greater part of these signs consists of individual vertical panels that are painted in the advertising company's shops and then bolted to the girts of the sign frame in the field. These panels usually consist of wood frames to which the sheet steel is tacked. For these panels each sign company has its own standards, which will determine the spacing and details of the girts.

Fig. 3—Suggested anchorage for a truss that carries a sign. Anchorage should be made as far below roof as possible to take advantage of a large amount of superimposed roof and wall load.



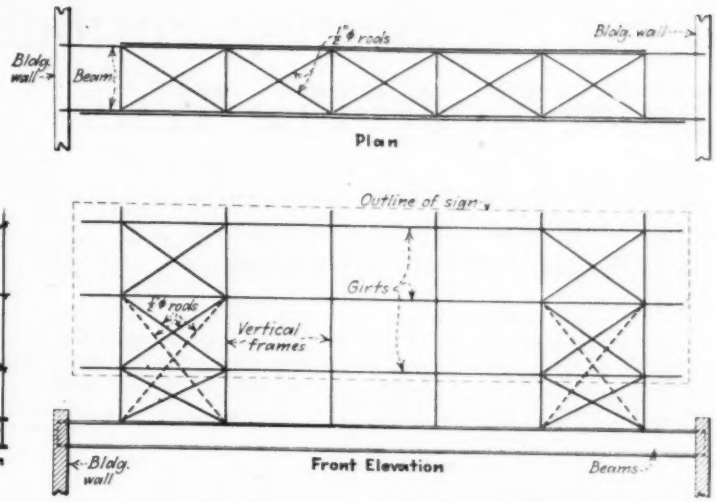


Fig. 5—Sign frame of angle-girt type. A series of vertical cantilever frames spaced 5 to 10 ft. apart support the girts carrying the sign face. Experience has demonstrated that the girt-type sign frame is simpler, easier to erect and more rigid than the horizontal truss type.

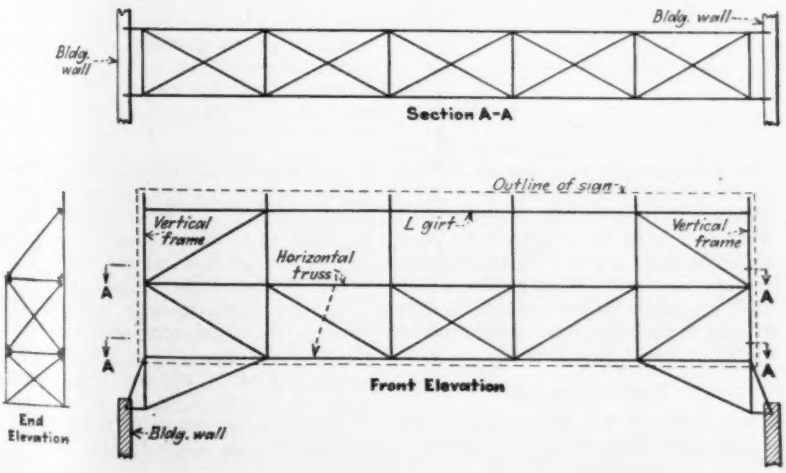
Special care should be taken to provide for any electrical equipment or display panels set into the face of the sign, since they may require special framing.

The sign frame

Given a certain vertical plane to support against wind loads, the designer has two basic types of sign frames from which to choose. One is a series of trusses in horizontal planes one above the other (Fig. 4). One chord of these trusses forms the girts for the sign face. These trusses carry the wind load out to two vertical cantilever frames, which in turn transmit the overturning effect and shear to the building frame or walls or to longitudinal beams or trusses anchored to the building.

The second type (Fig. 5) consists of a series of horizontal angle girts behind the sign face supported by a row of vertical cantilever frames spaced from 5 to 10 ft. apart, which in turn are carried by horizontal beams or trusses anchored to the building frame or walls.

Fig. 4—Sign frame of horizontal truss type. The trusses transmit wind load to vertical end frames that are anchored to the building. One chord of the horizontal trusses forms the girts for the sign face.



It has been found (through cut-and-try largely) that the second type is generally simpler, lighter and easier to erect, besides being more rigid than the first type.

For convenience in detailing, shop work and erection, all parts should be duplicated so far as possible, even though it may mean that a number of open holes may be unused. So that there may be no movement of the sign, except that due to elastic deformation, all bracing should be made tight, either by means of threaded rods or by angles with a small amount of draw in them. Signs of the second type more than 35 ft. long should have two sets of diagonal bracing between the vertical frames, while under that length one set is usually sufficient. A common error is to use too light angles for the girts, thus making a greater number of vertical frames necessary.

The duplication of the vertical frames offers an excellent opportunity for the use of welding, thus avoiding the gusset plates at their panel points. Due, however, to the fact that the girts may be relocated or the entire sign dismantled and re-erected on some other location, field-welding is seldom advisable.

For the support of the vertical sign frames the use of wide-flange sections is to be commended, since the lateral rigidity, ease of painting and small headroom required are especially desirable in this sort of construction.

The outdoor-sign industry uses in normal times not less than 20,000 tons of structural steel, most of which is highly fabricated, so that it is a customer to be cultivated. All spectaculars and most roof signs furnish an excellent opportunity for technically trained men both for design and for detailing.

New Pile-Bearing Formula From Model-Pile Tests

Tests of model piles indicate bearing-power characteristics of different shapes in sand and clay and suggest new pile-bearing formula

By L. C. Wilcoxen
Assistant Civil Engineer, City Engineers Office, Detroit, Mich.

USING simple home-made apparatus that can be duplicated anywhere, the tests described in the following article indicate possibilities of useful study of pile action in soils without excessive cost. Briefly these particular tests were directed, first, to indicate resistance of piles of several shapes where pressed into sand and clay and, second, the behavior of these piles when driven by impact. From the results of the impact tests a new pile-bearing formula is determined. —EDITOR.

RESULTS that help to elucidate a number of questions of pile mechanics have been obtained from tests recently made with simple apparatus devised by the author. Fig. 1 is a diagram of the apparatus. The counterbalanced overhead beam is a 2x4-in. timber. One or both of the spring scales, which are each calibrated to 50 lb., may be used in pulling down the beam end. The thrust leg is a ⅜-in. aluminum tube, the lower end of which receives the birch dowels that top the model piles used in the tests.

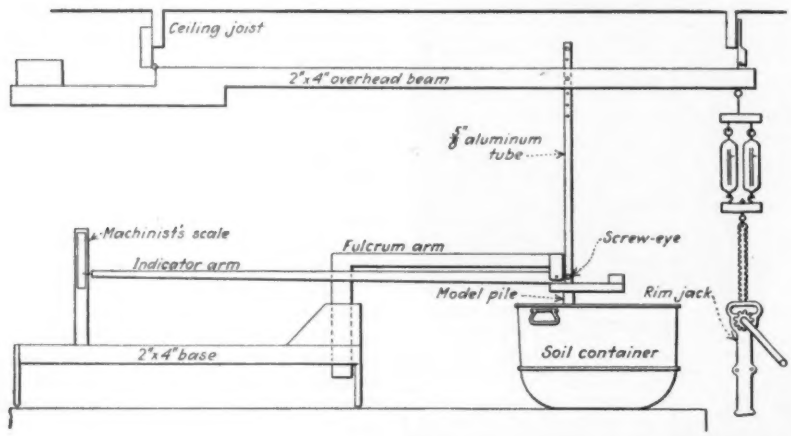


Fig. 1—Diagram of device used in making penetration and impact tests of model piles.

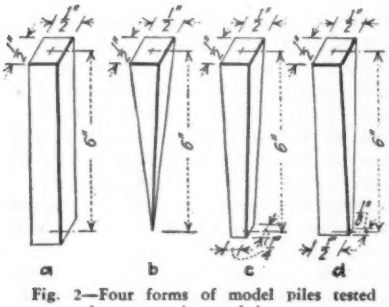


Fig. 2—Four forms of model piles tested for penetration and impact.

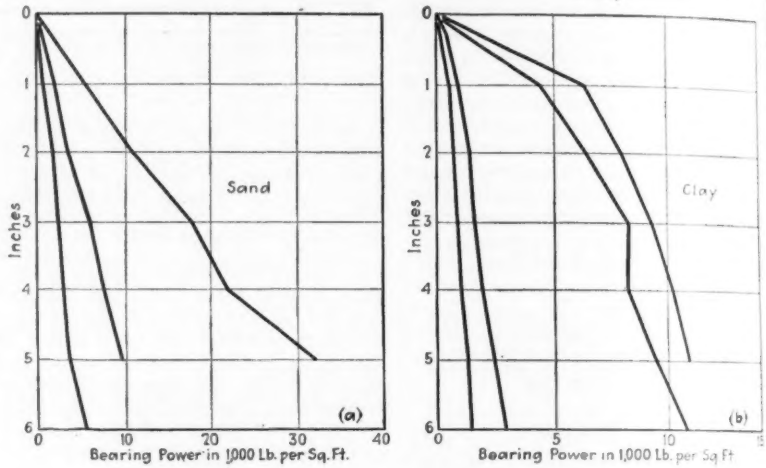
The settlement-recording portion is independent and was used only in the tests that developed the new impact formula. The wood fulcrum arm may be adjusted vertically. The counterbalanced indicator arm is 50 in. to the needle point, while the short arm is 1 in. to the center of the screw eye. Gage readings were made to 0.01 in. on the machinists' scale, so that minimum actual settlements of 0.0002 in. could be recorded.

Penetration tests

The first test was planned to develop the characteristics of two types of soils. A non-tapered pile (Fig. 2*a*) was driven vertically into a metal basket of sand which, between trials, had been jounced so that it had assumed three different densities. Fig. 3*a* shows that the ultimate bearing power of a sand, when determined in this manner, is proportional to its depth.

The test was next repeated in a clay of three different consistencies, obtained by changing the moisture content. The test on the stiffest clay was repeated a second time. Fig. 3*b* shows the results, which are dissimilar to those in sand. The ultimate bearing power

Fig. 3—Graph of ultimate bearing power of non-tapered pile: *(a)* in three densities of sand, and *(b)* in three consistencies of clay.



of these clays increased with depth but at a decreasing rate.

Before proceeding with tests upon the tapered pile a mathematical analysis was made of its bearing-power characteristics. It was assumed that the bearing power of any horizontal section of width *dh* (Fig. 4) would be the area of its vertical projection, times its depth in the soil and times a constant that represented the bearing-power characteristic of the soil. This is expressed by:

$$\Delta p = \Delta a \times (l-h) \times c = \frac{2S_1^2 dh(l-h)c}{l^2}$$

which when integrated gives the bearing power of the pile as

$$P = \frac{CS^2}{3}$$

As the width of the top is proportional to its length, it is apparent that the bearing power of a tapered pile may be expected to be proportional to the cube of its penetration in the soil.

Fig. 5 shows the results when pile (Fig. 2*b*) is successively forced into a sand of three different densities. The chart being drawn on a log scale, the points fall along straight lines with a slope of roughly 3 on 1. They closely parallel the perfect cube slope that is indicated by the dashed line. This test

checks the mathematical analysis just made, the most important part of which was the assumption that the bearing power of a pile is derived from its vertically projected incremental areas at their successive depths.

As the bearing power of clay has been shown not to be proportional to its depth, the above formula fails to be true for that class of soil. As might be expected, the three curves of the bearing power of the same pile in clays of different densities (Fig. 6) have decreasing slopes as the penetration increases.

A surprising feature of this test is the effect of the shape of the pile upon the bearing-power characteristic of the sand. For each of the three densities upon which the test was made the characteristic was computed from the formula $P = \frac{C S^2}{3}$. Fig. 7 shows the results.

For each case the characteristic has been markedly increased, the average being 360 per cent of what it was for the non-tapered pile.

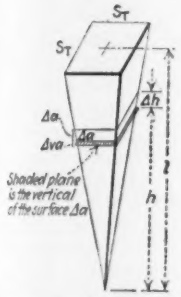


Fig. 4—Graph illustrating method of calculating bearing power of tapered pile.

A second surprising feature was the fact that the non-tapered pile increased the soil characteristics of the clays in much the same manner as it did for the sands.

The next pile to be investigated was the truncated tapered pile (Fig. 2c). Assuming one soil characteristic of bearing power for the sides C_s and another for the bottom C_b, an extended general formula is obtained. This, however, for the six successive 1-in. depths yields:

$$\begin{aligned} C_s = &-4.82\, C_b + 133{,}000\, P_1 \\ &-2.85 \quad 39{,}000\, P_2 \\ &-1.75 \quad 16{,}300\, P_3 \\ &-1.24 \quad 8{,}550\, P_4 \\ &-0.94 \quad 5{,}200\, P_5 \\ &-0.75 \quad 3{,}460\, P_6 \end{aligned}$$

in which P equals pile-bearing power, and C_s and C_b equal the bearing-power characteristics of the soil on the sides and bottom, in pounds per square foot per foot of depth.

Three tests were then made by driving this pile into the sand, which, between tests, was again jounced to give the three different densities. At each 1-in. depth the bearing power P was noted. The soil characteristics of the sides and bottom C_s and C_b were then determined by applying the method of least squares to the above six equations. The results are also shown on the graph Fig. 7.

Note particularly that while the bearing-power characteristic of the soil on the sides was enormously increased (average 620 per cent of that for the non-tapered pile), that for the bottom was actually decreased. Apparently the sand at the sides was compacted by wedge action, while that beneath the bottom was partly wedged away by the action of the sides.

The test was repeated in the sand, using the truncated wedge pile shown by Fig. 2d. The bearing-power equations were computed for the six 1-in. depths, and the actual characteristics were determined as in the preceding case. Fig. 7 shows the results, which are quite similar to those of the truncated tapered pile.

No tests with these piles were made upon the clays, as this method of analysis could not be applied to them.

These tests prove just how the bearing power of various piles in sands is distributed. Fig. 8 shows the bearing-power distribution of two of the models tested in sand. If it were possible to determine the same for clays, it

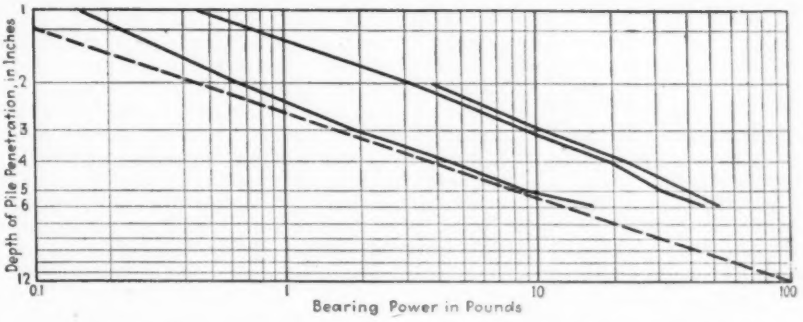
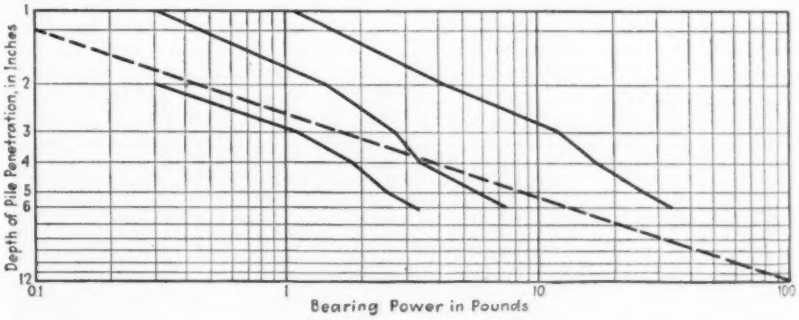


Fig. 5 (above)—Bearing power of pointed pile (Fig. 2b) in relation to its penetration in sand of different densities.

Fig. 6 (below)—Bearing power of pointed pile (Fig. 2b) in relation to penetration in clay of different consistencies.



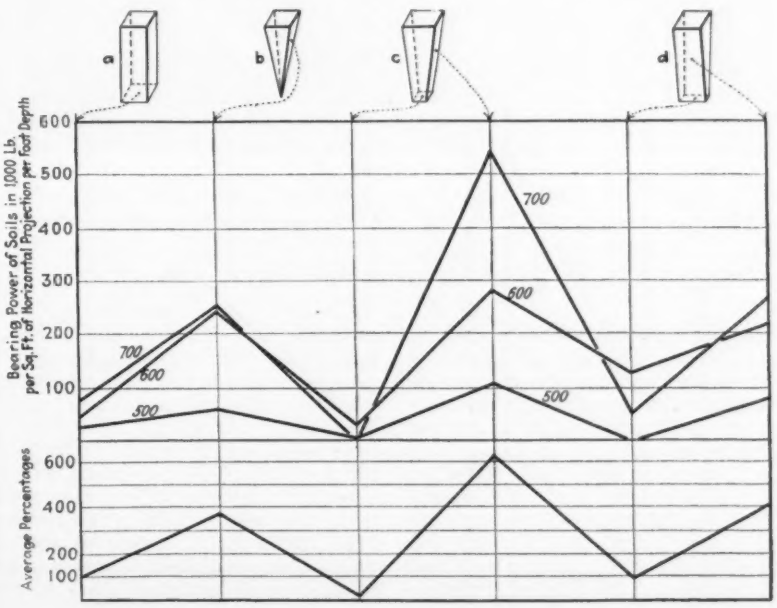


Fig. 7—Bearing power of different parts of different piles in a sand of different densities.

would be found that the curves would be distorted with relatively greater bearing power toward the tops.

Impact tests

By the use of impact tests upon model piles a new pile-bearing formula has been developed that the writer feels quite sure to be correct for all types of soils. The solution of the problem proved relatively simple. What would have been exceedingly difficult to determine in the field was rendered easy with the use of model piles and drivers.

The tests were made using non-tapered piles because this type facilitated interpolation of the bearing power between the points the bearing power of which was actually measured. The 1-ft.-lb. impact was obtained by a 1-lb. cylindrical weight of lead that was pierced to slide on a $\frac{3}{8}$-in. dowel. This weight was dropped a distance of 1 ft. upon the head of the pile. A cylindrical weight of lead weighing 0.1 lb. (about 3 in. long) was made to slide in a metal tube and was dropped a distance of 1.0 ft. and 0.1 ft. to obtain impacts of 0.10 and 0.01 ft.-lb. A special device was also made so that the same weight could be rapidly dropped a large number of times a distance of 0.01 ft. The resulting impact of 0.001 ft.-lb. was so small that it was generally desirable to register several hundred impacts before recording the consequent settlement. Settlements were recorded by the apparatus previously described.

The tests were made upon six soils, three being clays with different consistencies and three sand with different densities.

The pile was first driven to a specific depth by use of the overhead beam and its bearing power noted from the balances. The pile was next driven by the full range of impacts, and in each case the consequent settlement was noted. After recording its final bearing power again by means of the balances, the intermediate bearing powers were interpolated. After some preliminary work the relationship between bearing power, impact and settlement was discovered. A schedule of tests was then run, the results of which are plotted on log scale (Fig. 9). This chart represents 1,657 impacts and 36 group-settlement recordings.

In the case of the softest clay (100 class on the chart) several observations with the same impact units are noted. They show the consistent results that may be obtained in spite of the extremely small settlements that are measured. The diagonal crosses at the left, for instance are each the result of thirty 0.01-ft.-lb. impacts, while the vertical crosses are the result of ten impacts each. Both the diagonal and vertical crosses at the center represent five 0.10-ft.-lb. impacts, while those at the right are each the result of single impacts of 1 ft.-lb. In the case of all other soils the results of all impacts are grouped for each impact unit. The straight lines have been drawn in by eye and approximate the curve for each class of soil.

A study of this chart clearly indicates that the relaionship between the factors of bearing power, impact and settlement is expressed by the formula

$$P = \frac{Wh}{S^n}$$

in which P = bearing power, in lb.
W = weight, in lb.
h = height, in ft., that the weight is dropt.
S = resulting settlement, in ft., due to impact.
n is a constant for each particular soil.

In field practice n will probably range between 0.60 and 1.00, approaching 1.00 as the soils become stiffer and denser.

In closing, it might be stated that the success of determining this new impact formula was due to the extremely wide range of impacts used. To obtain the same test results in the field would be extremely difficult and very costly.

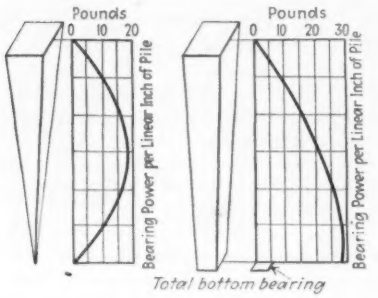


Fig. 8—Distribution of bearings along the lengths of piles (Fig. 2*b* and *c*) in sand.

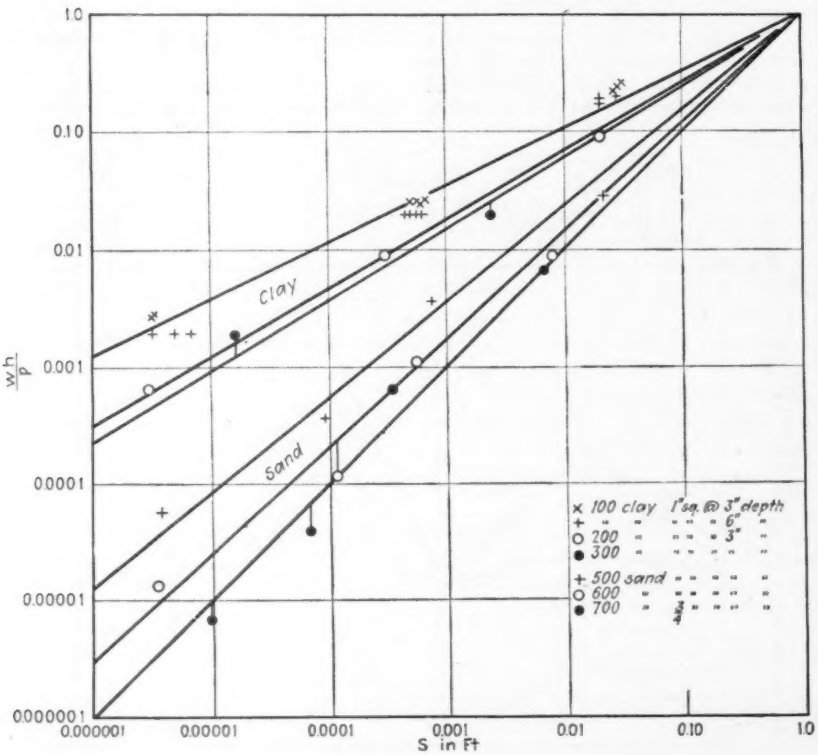


Fig. 9—Impact-bearing-power ratios plotted against resulting distances to while piles are driven in clay of three consistencies and sand of three densities.

Portland Cement Statistics, 1931

According to the United States Bureau of Mines, production of portland cement in 1931 was 125,429,071 bbl., a decrease of 22 per cent from 1930, and 29 per cent from 1928, the highest year of production; and it is the lowest recorded production since 1922. Shipments in 1931 amounted to 127,150,534 bbl. valued at $140,976,450, a decrease of 20 per cent in quantity and of more than 38 per cent in gross value. The average factory price per barrel in bulk in 1931 was $1.11, a decrease of 33c. per barrel as compared with 1930. Producers' stocks on hand Dec. 31, 1931 (about 25,000,000 bbl.) showed a decrease of 7 per cent from the large stocks on hand Dec. 31, 1930.

The commercial capacity for production of finished portland cement of the 160 shipping plants in 1931, and of five plants inactive in 1931 but producing within the four previous years, according to manufacturers' reports supplemented by a few estimates, was 271,850,000 bbl. There were no new plants reported as entering production in 1931. The total production for 1931 was 46.1 per cent of the indicated capacity at the close of the year. The corresponding figure for 1930 was 59.7 per cent.

New Station Added to Boston Elevated

Structure at Charles St., 150 ft. long and built without interrupting traffic, required reinforcing of old viaduct and use of ingenious structural expedients

By Lewis E. Moore
Consulting Engineer, Boston, Mass.

THE NEW Charles St. station for the Boston elevated railway at the junction of Cambridge and Charles Sts. on the line from Park St. to Harvard Square, Cambridge, necessitated the use of some unusual structural expedients. The design was complicated since traffic on the elevated railway could not be interrupted and that on the street below could not be interfered with unduly. Much of the weight of the station had to be carried on the existing viaduct, so that the task was as much one of reinforcing the old steelwork as it was of building a new station.

The elevated railway property between Boston and Elliott Square, which is beyond Harvard Square, Cambridge, is owned by the Commonwealth of Massachusetts and is leased to the Boston Elevated Railway Co. In 1924 the state legislature passed an act which called for the construction of a station, but a study revealed that it could not be built within the appropriation of $600,000 which had been made. An additional appropriation was refused by the legislature, and the plan then became dormant until 1930. In that year the city of Boston, through a special act of the legislature, decided to widen certain adjacent streets and to construct a large traffic circle at the site of the proposed station. This revived the station project, and work was commenced upon it. The station was opened Feb. 29, 1932. It is used extensively by those going to and from the Massachusetts General Hospital, the Massachusetts Eye and Ear Infirmary and by the residents of Beacon Hill, as well as those desiring to attend the concerts given on the Esplanade of the Charles River during the summer.

The construction of the station and of the traffic circle was carried on simultaneously by independent agencies and independent contractors. Fig. 1 shows the completed station and circle. On account of the curve in the elevated viaduct, the station was extended out onto the bridge approach a distance of 150 ft., as shown in Fig. 2.

In order to avoid delays to street traffic and to the work of building the circle, and at the same time to save all possible expense in construction, falsework was avoided, and the old construction was permanently riveted to the new before any alterations were made in the old which would materially affect its strength. In Fig. 3, which is a cross-section of the structure, it will be seen that in order to build the platforms it was necessary to cut down the old side girders. The decreased depth would require much heavier flanges than the original ones if these girders were still to carry their original load, to say nothing of the added load due to the platforms and shelters. It was impossible to strengthen the bottom flanges unless the concrete (some 30 in. thick) on the side toward the track were removed. Welding was out of the question on account of inaccessibility on the inner side and also because the rivets connecting the flange to the web would become inadequate if the girder depth were reduced. The flange rivets could not be strengthened unless the concrete were removed. It was therefore decided to install new girders 18 in. on centers outside the old ones and to connect the old to the new by diaphragms opposite the floor beams, which are about 7 ft. apart. After the new girders were in place and the diaphragms riveted up, the webs of the old girders were burned through on a horizontal line about 2½ ft. below their tops, and the upper parts removed. This transferred the load to the new girders.

Careful computations showed that there was no real need of jacking up the old girders before riveting the diaphragms in order to make sure that the new outer girders received their full load. Under the most unfavorable reasonable assumptions it was found that the extra load transferred to the center girder by the omission of jacking would not stress it unduly, and therefore the expense of jacking the side girders could be saved with entire propriety. The diaphragms were riveted between trains in order to avoid variable deflections. Avoiding the

Fig. 1—New Charles St. station on the Boston elevated railway. View taken looking across Longfellow Bridge toward Cambridge. Traffic circle was built simultaneously with station.

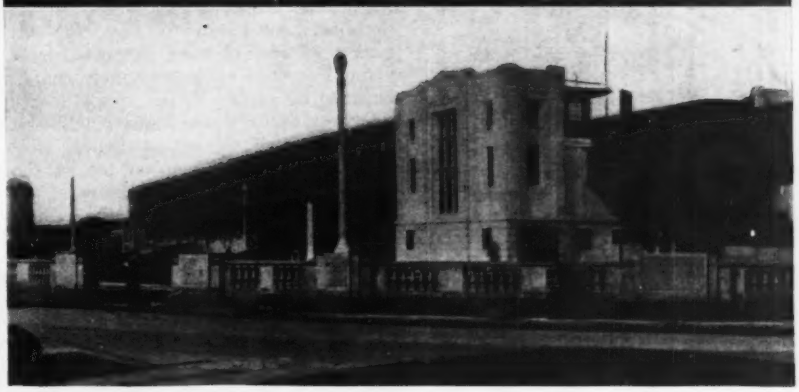


Fig. 2—A station building faced with artificial stone and a platform shed sheathed with copper characterize the new Charles St. elevated station in Boston. The weight of the new construction is largely carried on the old viaduct structure, which had to be strengthened.

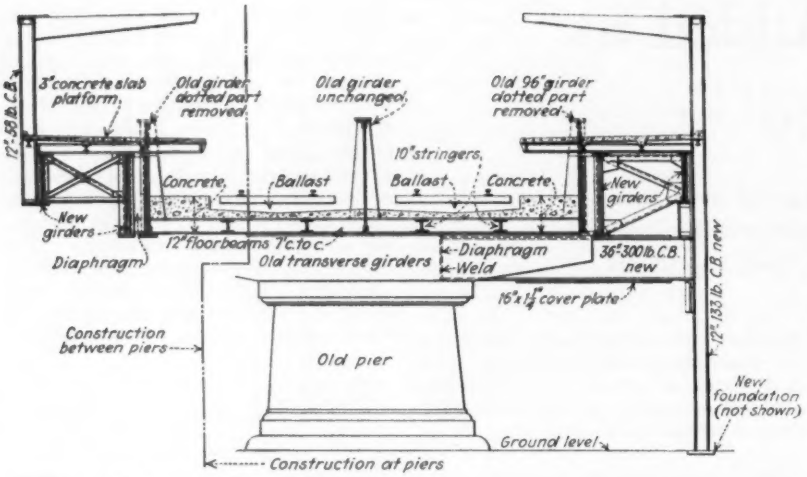


Fig. 3 — Viaduct reconstruction plan that provided for new Charles St. station. New transverse girders were inserted between existing pair, and new longitudinal girders were attached to old girders by diaphragms.

falsework for jacking not only saved direct expense but made it possible for the city to carry on its street construction under the structure without serious interruption to either the traffic or the work. Traffic originally passed under the second span from the bridge. The circular roadway was constructed under the first span.

Figs. 3 and 5 show the support of the original girders on piers. The new

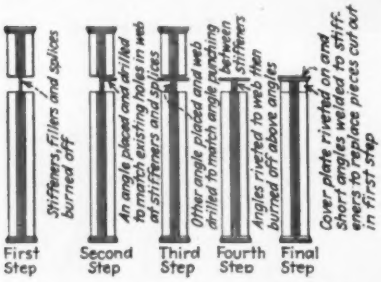

Stiffeners, fillers and splices burned off
An angle placed and drilled to match existing holes in web at stiffeners and splices
Other angle placed and web drilled to match angle punching between stiffeners
Angles riveted to web then burned off above angles
Cover plate riveted on and short angles welded to stiffeners to replace pieces cut out in first step
First Step
Second Step
Third Step
Fourth Step
Final Step

Fig. 4—Steps in cutting down depth of old side girders within area of new station building on Boston elevated.

girders and the station platforms were too heavy to be located on the old transverse girders, so it became necessary to install new girders. These were inserted between the two original tapered girders and rested on top of the piers. They were welded to an existing diaphragm that joined these pairs of tapered girders. Each new girder was carried at its outer end on a column resting on a concrete base supported on composite piles. The column had to be located outside the old structure in order to have head room to drive the piles. This type of construction was followed on the two spans adjacent to the masonry approach to the bridge.

The third span was wholly within the traffic circle and was largely included within the station building. Because of stairway interference, headroom, etc., a different type of construction was used here. The old side girders of span 3 were supported by a permanent steel column at their center. Because of scanty flange and stiffener rivets to carry the column reaction it was necessary to put a heavy steel corbel about 7 ft. long on top of the column and extending lengthwise of and welded to the bottom of the girder. Both column and corbel are shown in Fig. 6. The girder and corbel were then jacked up near the column sufficiently to remove all the dead-load deflection. Plates were inserted to take up all the space between the column top and the corbel. The girder was then lowered to its permanent position on the column. The stiffeners, fillers and web splices of the girder were then cut through on two horizontal lines at the top and bottom of the proposed new top flange. Care was taken not to cut the web, so that the old top flange would continue to function. Two new flange angles were riveted on as shown in Fig. 4. These flange angles alone were of ample strength to carry the new flange stresses. The web was then cut above the new flange angles, and the old top flange was removed. A cover-plate was then riveted onto the new top flange angle for a finish. No effort was made to put dead-load stress into

Fig. 5—Three spans of original viaduct adjacent to bridge approach, which were reinforced to carry new station and platforms. Station floor is under construction in foreground beneath third span.

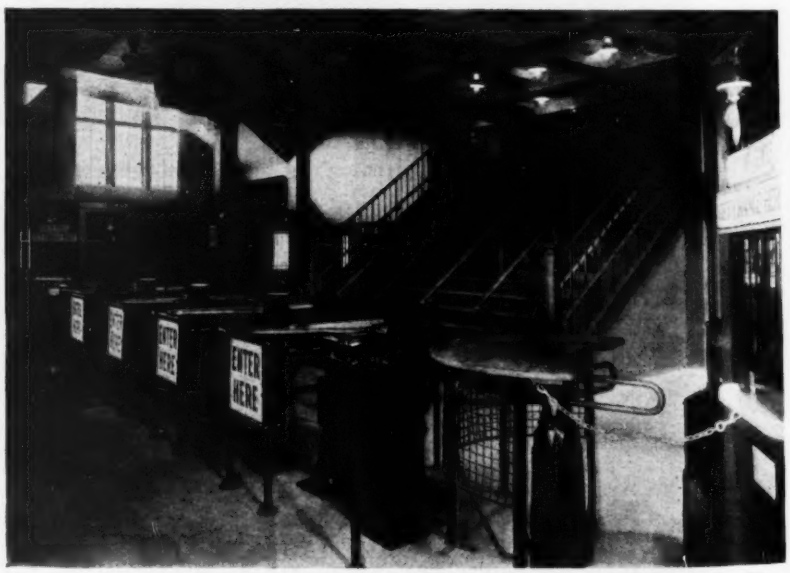


Fig. 6—Interior of new Charles St. station on Boston elevated railway.

the coverplate as it was all excess area anyway. Because of cutting the span in half the old bottom flange was more than adequate to take care of the new distribution of stress.

As it was impossible to put a pile foundation directly under this column, it and its mate under the opposite girder were carried on a heavy concrete grade beam at right angles to the track, which in turn rested on the foundation piles.

The heavy columns at the end of the bridge approach rest on the concrete footing of the bridge approach, which is amply strong to carry it. These columns are very heavy because of a considerable bending moment due to eccentric loading. The small columns alongside the bridge approach masonry (Fig. 2) rest on small concrete piers in the soil. In order to have sufficient platform width it was necessary to narrow the roadway somewhat on both sides of the bridge approach to clear these columns. Each roadway, however, is wide enough for two lines of traffic.

The foundation problem under the station was complicated by the presence of two sewers. One is an old 2x4-ft. intercepting brick sewer on a wooden platform that crosses the site diagonally under one wall of the station, and the other is the main sewer on Cambridge St. These sewers intersected under the station building. The character of the soil, which was made land and largely gravel, made a pile foundation the most suitable solution. As there is no cellar under the station and as the walls are all carried on grade beams near the surface, the type of pile became important. The most economical pile was decided to be a composite one of wood and concrete. The wood pile was driven until its top was at grade 1, and a concrete pile cast in place was used from that level up to the grade beams.

The station building is constructed of artificial stone. The station walls are sheathed inside with kalamein and covered outside with copper. The stairways are entirely within the station (Fig. 6) and are of steel with concrete landings.

The total cost of the station was about $191,000. The planning and construction was done by the state department of public utilities under the immediate direction of William J. Keefe, chief engineer, with the writer acting as consulting engineer and William Stanley Parker as consulting architect. J. Slotnik Co., Boston, was the contractor.

Corewall in Rockfill Dam Tilts When Reservoir Fills

Vertical concrete core in Oued Kébir dam of Tunis water-supply system shears and leans with first water load—Repairs made and dam strengthened

By F. A. Noetzli
Consulting Engineer, Los Angeles, Calif.

TILTING and shearing of the concrete corewall in the Oued Kébir rockfill dam, a structure in the water-supply system of the city of Tunis, northern Africa, resulted from the first filling of the reservoir in 1929. The amount of horizontal displacement was about 5 in. at the base of the corewall and 2 ft. 8 in. at the crest. When the reservoir was emptied for the purpose of repairing the dam, the corewall moved back again, although not quite into its original position. The dam was repaired in 1930-31 by providing a new connection and seal between the corewall and the cutoff wall and by strengthening the fill. The success of this operation remains uncertain because, as far as reported, the reservoir has not been filled since the dam was repaired and strengthened.

Description of dam

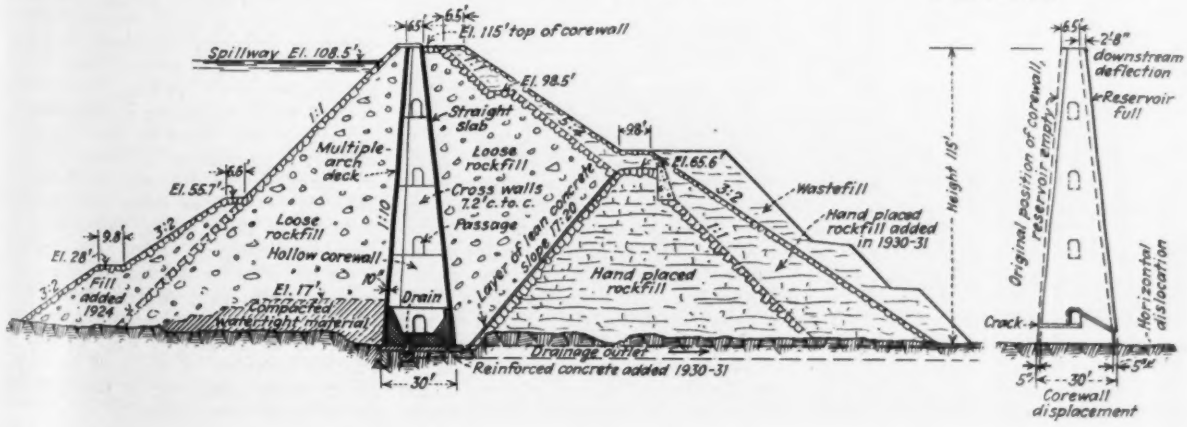
The Oued Kébir dam is located about 50 miles south of the city of Tunis, the capital of the French colony of the same name in North Africa. It is a structure of the rockfill type, 115 ft. high and 1,140 ft. long at the crest, forming a reservoir of 21,000-acre-ft. capacity for the water-supply system of Tunis. The maximum cross-section of the dam is shown in Fig. 1.

The outstanding feature of the dam is a hollow vertical corewall with an overall thickness of 6½ ft. at the top and 30 ft. at the base. The thickness of the hollow wall is therefore about one-fourth the height of the dam. The upstream face of the wall is formed by a series of arch barrels of about 7-ft. span each. The downstream face is of ordinary reinforced-concrete slab construction. Crosswalls extending for the full height of the corewall serve as spacers between the upstream and the downstream faces. Openings in the crosswalls and connecting footbridges provide accessibility to the interior.

The fill on the upstream side of the corewall consists of fragments of rock dumped loosely from cars, with a facing of hand-placed rock. Original plans provided for an upstream slope of 1:1 for this fill, but this proved too steep, and during the construction some fill material was added that flattened the average slope.

The downstream toe of the dam consists of a large embankment of hand-placed rock. The upstream face of this embankment was smoothed out with a layer of lean concrete to provide a smooth-sliding plane to produce wedge action for the body of loose rockfill

Maximum section of the Oued Kébir dam, showing relative position of the corewall and elements of rockfill, also the deflection of the corewall caused by the first filling of the reservoir.



between this placed section and the corewall. The material of the loose rockfill consists mainly of fragments of quarry rock weighing not less than 12 lb. each. Quarry waste of smaller size was systematically incorporated in the fill to the extent of 10 per cent in the downstream fill and 20 per cent in the upstream fill. The downstream face of the dam is also paved with a layer of hand-placed rock.

Effect of water load

Shortly after completion of the dam early in 1925 occasional cloudbursts in the watershed of the wash brought some runoff into the reservoir. By October of that year the water level stood at about one-half the height of the dam. A settlement of the rockfill on both the up- and downstream sides of the corewall was observed, amounting to about 2 ft. at the maximum section. During the following four years the water level in the reservoir varied but little.

In March, 1929, a flood filled the reservoir to within 6 in. of the lip of the spillway, which was 7 ft. below the crest of the dam. Under this load the rockfill settled considerably, and the corewall suffered a downstream deflection of 2 ft. 8 in. at the top. At several places the downstream face of the fill started to bulge, and some pieces of the facing rock broke out. Leakage developed at the base of the dam, thus indicating that the corewall had been damaged. As a precaution, the water level in the reservoir was immediately lowered. Subsequently the reservoir was emptied completely for inspection and repair of the dam. While the dam was being relieved of its load, the corewall moved gradually upstream but did not return quite into its original position.

After the reservoir had been emptied, it was discovered that the corewall had been sheared off from the cutoff wall and had been bent and tilted in a downstream direction, the horizontal displacement being 5 in. at the base and 2 ft. 8 in. at the crest. There were a number of horizontal tension cracks in the arched upstream deck of the corewall and shear cracks in some of the crosswalls. The tilting of the corewall had lifted its upstream deck from the foundation by several inches, thus admitting water from the reservoir through the upstream rockfill into the cells of the wall.

The dam was repaired in 1930-31 by filling the lowest parts of the cells of the corewall with concrete and by anchoring this new mass to the cutoff wall and to the foundation rock. Also the cracks in the arched deck and in the crosswalls were repaired. The downstream fill was strengthened by the addition of fill material at the toe of the dam.

A complete description of the construction and subsequent repair of the dam appeared in *La Revue Industrielle*, September, 1931, by G. Arbelot, member of the French committee on high dams.

Remarks

The behavior of the Oued Kébir rockfill dam offers several important lessons:

1. It shows the fallacy of trying to support a relatively stiff seal wall by fill material, which is subject to irregular and relatively large displacements.

The principle of the laminated type of upstream facing or seal featured in the most modern rockfill design—notably, several high dams in Chile (*ENR*, Nov. 5, 1931, p. 725) and the flood-control dams to be built on the San Gabriel River in southern California—is far superior to the stiff type. Provision for flexibility is important to eliminate serious cracking of the seal in the inevitable settling of the fill material.

2. Means for inspecting the interior of certain types of dams are apparently of service only as long as nothing happens to the dam. They seem to be of little use in cases of emergency, when they may be submerged and inaccessible. They may even be a source of danger.

The design of the Oued Kébir dam is open to criticism for the reason that a rockfill dam with a vertical corewall in the center leaves only about one-half of the fill—namely, the downstream portion—available for resisting the water pressure. Horizontal compacting of the fill due to the horizontal pressure of the water upon a nearly vertical corewall is unavoidable, because even the best kind of fill is at least slightly compressible. This introduces a tendency of shearing off a vertical corewall at the foundation. The corewall of the Oued Kébir dam was not only sheared off but it suffered in the shearing plane a horizontal displacement of about 5 in. Furthermore, because of its stiffness in a vertical direction, it was tilted and on the water side lifted off its base.

The method of repairing the Oued Kébir dam also invites discussion. Repairs could be made only after the reservoir had been completely emptied. It was observed that when the dam was relieved of the water load, the corewall tilted back toward its original position. Although it was subsequently partly filled with concrete and was anchored to the foundation in this intermediate position, the next filling of the reservoir will undoubtedly deflect both dam and corewall again, though probably somewhat less than on the occasion of the first filling. Nevertheless, on account of its stiffness the corewall will not be able to deflect elastically as much as the fill is likely to move, so that a renewed tilting and cracking of the wall would seem unavoidable. On account of the newly provided heavy mass of concrete at the bottom of the corewall it is probable that the new tilting will occur just above the top of the solid portion.

The bulging of the fill at several places on the downstream face of the dam during the first filling of the reservoir in 1929 was an unmistakable sign that the stability of the fill was taxed almost to the limit. It should be noted that this occurred when the water level was still about 7 ft. below the crest of the dam. Fortunately, the dam was strengthened very materially in 1930-31 by the addition of fill material on the downstream side, as indicated in Fig. 1.

The events accompanying the first filling of the reservoir seem to indicate that the type of corewall as built for the Oued Kébir dam is not a very suitable structure. The upstream deck of the corewall is 4 in. thick at the top and 10 in. thick at the base. This thin diaphragm was fully capable of withstanding the head of water imposed upon the dam and the pressure of the upstream rockfill. Consequently, if a diaphragm of equal thickness, or preferably a laminated diaphragm of two layers, had been placed upon the 1:1 slope of the upstream fill and covered to the top of the dam by a fill on a 3:2 slope for protection, the extra cost of the hollow corewall and the hand-placed toe embankment could have been saved. The stability of the dam as a whole would have been increased, because practically the entire fill would have been available for resisting the water pressure.

Still more important is the fact that the circumstances indicate a rather disturbing structural weakness of the dam as a whole. It is doubtful whether the repairs as described by Mr. Arbelot have removed the fundamental sources of trouble and have strengthened the dam sufficiently to provide for it as large a factor of safety as is desirable for a structure of the importance of the Oued Kébir dam.

Etching of Nails Increases Their Holding Power

The use of a chemical treatment that produces microscopic pitting or etching of the surface of nails, thereby increasing their frictional resistance to wood, has been developed by the Forest Products Laboratory, Madison, Wis. The desired pitted condition is obtained by subjecting the nails to the action of a 2 per cent solution of ferric chloride in water in the presence of mercuric chloride or salts of other metals, particularly of those falling below iron in the electro-chemical series. On removal from the solution the materials are allowed to dry in a warm atmosphere, after which they are exposed at a temperature of about 100 deg. C. and a relative humidity of about 80 per cent, being finally immersed in water to fix the adhering iron oxide.

Truck-Mounted Plant for Bituminous Mix

Several units of standard asphalt plants are mounted by Colorado road contractor on truck chassis with pneumatic tires and moved at regular highway speeds

By Marion T. York and Albert Hack
Denver, Colo.

ORDINARILY an asphalt plant for road work is a semi-permanent structure, representing a large investment. In the event such a plant must be moved salvage of anything but the actual machinery is practically impossible. To do away with the permanence of such a plant, as well as to lower the cost of transporting heavy machinery from place to place, there has recently been designed a plant, mounted on pneumatically tired wheels and moving under its own power. The plant is now in use as described.

Crushing and screening units of unusual design are provided so that any stone may be used in the process, these units being unnecessary when the plant is being operated on pit run gravel. The screening unit is mounted on stilts so that it may be lowered over the dryer, no matter what its elevation. Gravel is carried to the screening unit by a standard bucket elevator.

The dryer for the aggregate is mounted on a 2½-ton truck chassis and is driven from a power take-off at the transmission. The radiator capacity of the truck was increased to provide the additional cooling necessary on long stationary runs. At the forward or feeding end of the dryer is a dust and expansion chamber which removes the fines from the dryer itself, and bypasses them to a conveyor discharging into the elevator boot at the discharge end. The remainder of the aggregate passes through the dryer where it is tumbled through the flames from the oil-fired blast at the discharge end.

The drum of the dryer is all-welded construction, and is so constructed that expansion from the great heat of the blast will not cause distortion. Longitudinal angles and baffle plates thoroughly winnow and tumble the aggregate during its passage through the dryer. The longitudinal angles are arranged so that they may expand separately from the drum. Dual exhaust fans mounted above the drum and behind the expansion chamber provide draft for the blast and move 36,000 cu.ft. per minute of heated air through the dryer. At the discharge end the dry material drops into the elevator boot, which may be reversed for either right- or left-hand operation. The drum is driven by sprockets and chain and is carried on two large chilled cast-iron trunnion rings resting on ball-bearing trunnion rolls. The trunnion rings are separated from the drum of the dryer by springs to allow for expansion. The firebox and discharge end of the dryer is removable in its entirety, requiring only the removal of ten bolts.

Likewise the boiler for heating the asphalt oil before it passes into the mixing plant is mounted on a truck. This boiler provides steam for preheating and atomizing the fuel oil used in the blasts for the burners in both boiler and dryer. When the plant is in operation the fireboxes of both boiler and dryer are placed so that one man may handle both fires. Steam pumps to handle both fuel and asphalt oil are mounted on the truck with the boiler.

The oil heating and storage tank consists of an insulated tank containing steam circulation coils and is mounted on elevators so that it may be raised to a height sufficient to provide gravity feed to the mixing plant, or lowered onto the bed of a truck.

The mixing plant is mounted on a special trailer and is belt-driven by a 150-hp. industrial motor. A bucket elevator lifts aggregate from the elevator boot of the dryer and discharges it onto a vibrating screen. An eccentric drive provides the head motion for the screen. Three punched plates mounted one above the other discharge the oversize to a special conveyor and separate the remainder into a four-compartment bin. Two of the bins are for the fines, 60 per cent of the aggregate being of that size. The aggregate is discharged into the weighing and proportioning bin just above the mixer. Alongside the proportioning bin is the oil bucket, a V-shaped trough with slotted sides. The bucket is pivoted at the apex of the V and by closing certain of the slots may be made to contain varying amounts of oil. A standard 3,000-lb. pugmill mixer is mounted below the bins.

The discharge conveyor is driven from the mixing plant by sprockets and chain. It is mounted on truck wheels. A long discharge span, set at a wide obtuse angle to the shorter loading span, reaches a height sufficient to load a truck. The loading span extends under the mixer. A 36-in. conveyor belt is driven from the head pulley on the upward span. The drive belt is 30 in. wide and passes around the drive pulley at the intersection of the two spans and around the head pulley under the conveyor belt. At a speed of 275 ft. per minute, the conveyor discharges 3,000 lb. of material in six seconds.

As the overall height of the mixing plant is 15 ft., the upper portion, including the vibrating screen, is arranged to fold down, providing road clearance for the structure.

Except at those points where field connections are necessary for dismounting, the entire plant is of arc-welded construction. It is of exceptionally sturdy design and all parts are of great weight to provide anchorage. Despite the great weight no difficulty is experienced in transporting this machinery at speeds of from 30 to 40 miles an hour on the highway. There is very little unsprung weight. This plant was used in the oiling of the Dupont Speedway, an automobile race track a few miles from Denver. Patents are being sought on much of the machinery. Albert Hack, engineer for C. V. Hallenbeck, a Denver contractor, designed this portable plant.

Portable road oil plant with the discharge conveyor in foreground discharging mixed material into a truck. To the right oil trucks are backed up under the elevated oil heating tank. To the left rear is the dryer being fed by a belt conveyor. No screening plant was used on this job.

Earthquake-Resistant Construction —Its Status Today

Unity of construction and rigidity of structure are now well understood to be fundamental to safety—Height limitations as related to rigidity—The place of flexible construction and its application to the Olympic Club Building

By Bailey Willis
Consulting Geological Engineer. Stanford University, Calif.

MATERIAL advances in practice and somewhat better understanding of requirements for earthquake resistance have been achieved since 1930 as a result of the discussions among structural engineers in San Francisco and Los Angeles, stimulated by the experimental investigations carried out on the shaking table at Stanford University. Now that we may anticipate renewed activity in building it seems appropriate briefly to summarize the present state of the situation.

Two well-established principles have been confirmed, and we have gained a better understanding of the reasons for them. They are *unity of construction* and *rigidity of structure*. That the alternative of *flexibility* may be considered in cases where rigidity cannot be attained within economic limits has also been shown, and the essential conditions for its application have been demonstrated.

Unity of construction

Unity of construction means that the structure shall be a coherent unit in which every part and all bonds between parts shall be equally competent to take the stresses to which they will be subjected individually.

In modern practice unity is secured in those structures that are firmly tied together by outside walls and floors of reinforced concrete, whether the frame be of reinforced concrete or steel. Reason for emphasis on the strength of exterior walls, floors and their connections with the frame lies in the development of dynamic stresses when the building is caused to swing. H. D. Dewell, so far as I know, was the first to state that the static stresses, which are calculated on the assumption that the building is at rest, would not obtain when it is set in motion. He also said frankly that there was no formula in which he had confidence by which the dynamic stresses could be calculated, unless the deflection of the building was known. It was then that L. Jacobsen proposed to construct a model which should have dynamic similitude with a proposed building and which should demonstrate on the shaking table the actual deflections that would result under given conditions. The results are familiar to engineers in San Francisco through the exhibition of moving pictures of the model in vibration.

It was shown in the course of the same study that strength in the exterior walls is of vital importance, because as much as 95 per cent of the total stresses may be transmitted to them, leaving only 5 per cent to be taken by the interior bents. The earthquake-resistant competency of a building depends upon the unity of its outside walls and floors as parts of a rigid, coherent whole.

Structures which do not possess coherent unity and strength are not earthquake-resistant, and constitute a menace to life and property.

Reasons for rigidity

The requirement of rigidity demands that the structure, when struck by a shock, shall deflect very slightly and return very quickly. A mere shiver is the ideal. This is an old idea, but it has been brought within practical limits in the recent investigations.

Any building has a definite swinging period, which is fixed by its proportions and construction and is characteristic of it. A number of measurements have been made on existing buildings, with the result that their periods are known and the range of periods may be inferred. Any earthquake presents very variable swinging periods in more or less rapid variation, but it appears that a minimum of ½ sec. and a maximum of 2 sec. are not likely to be passed.

The maximum stresses develop in a building when it swings in unison with the vibrations of the ground. They are apt to become destructive if the building and the earthquake keep step during three or four oscillations, since then the mass action of the building may be brought to bear upon its weakest part. Coincidence of periods produces resonance. To avoid resonance, we should design so that the period of swing of the building shall be either less or greater than the expectable period of vibration of the ground.

If a building can be so rigid that it merely shivers, if its period is less than ½ sec., resonance is not likely to occur. For buildings of five or six stories, and probably up to ten or twelve stories in most cases, this degree of rigidity can be obtained by monolithic construction of reinforced concrete or, where for any reason a steel frame is preferred, by embedding the frame in concrete walls and floors, with suitable reinforcing steel and bonds throughout the structure. There is at present in current practice no other material than reinforced concrete or possibly reinforced brick that is strong enough or can be bonded properly to give the required rigidity.

When flexible support is appropriate

There are practical limits to the principle of rigidity. On any given building each added story tends to increase the period of swing; beyond ten stories, more or less, it becomes uneconomical to make the structure rigid enough. The proper recourse then is to introduce a flexible support, preferably in the basement columns, upon which the structure shall swing with a long slow motion.

The effect cannot be achieved by guessing. It is true that any steel frame is flexible and will react to an impulse applied by an earthquake in such a manner as to sway to and fro. Even if embedded in weak walls, such a frame may become flexible after the walls are wrecked. But the initial, instantaneous reaction of the structure is that of weak rigidity, and failure is the result. Unfortunately, there are buildings designed and erected on that assumption, but they are guesses, not engineering, for no one knows what they will do. The degree of flexibility, the amount of deflection and the stresses that will be imposed upon the deflecting members should be determined *accurately* by calculation and experiment.

This result may best be accomplished, so far as now appears, by confining the flexibility to simple columns, whose length, cross-section and elastic modulus are known, and whose deflection under a given stress can be determined. In order that they should give the calculated effect, these columns must be free to deflect without other restraint than their resistance; confining walls are not permissible. For that reason basement columns are most convenient. The depth of the basement and consequently the length of the columns being fixed, the cross-section of the latter must be such as to give the required flexibility. Where this cross-section is less than that required to support the column load, pairs or groups may be used. Basement floors should be carried on independant short columns and should extend from retaining wall to retaining wall to give necessary support.

This type of flexible construction was recommended for the new Olympic Club Building, after months of study by a committee of engineers selected for their

special understanding of earthquake effects, and only after the prevailing opinion in favor of rigid construction had been overcome by the evidence of resonance that was furnished by testing the dynamic model on the Stanford shaking table.

It was found, furthermore, that even though the flexible basement columns furnished the desired condition of long slow motion, it was still essential that the superstructure, from the street floor up, should be rigid. The problem of design is, however, simplified, since the flexible support afforded by the basement columns has a definite calculated swing, and the dynamic stresses to which the superstructure will be subjected may be determined by appropriate tests with a model on the shaking table. The general principle of rigid design—namely, that the building must be a coherent whole—applies to the superstructure in this connection, just as if the building stood upon the ground, and can be met only by unity, strength and rigidity of frame, walls and floors.

It is gratifying that insurance engineers have kept up with the latest advances in research in the matter of earthquake-resistant construction and that rates for earthquake insurance are adjusted accordingly. By far the greater number of buildings that are insured are designed for rigidity, and to secure the lowest rates they must now have reinforced-concrete walls throughout and reinforced-concrete partitions where irregular distribution of masses destroys unity of the whole. The walls and partitions, not the frame, are the dependence for resistance. This is sound procedure from the point of view of structural principles and is borne out by the behavior of such buildings as those erected by Professor Naito in Tokyo.

There was formerly a perference among engineers as well as among investors for the steel frame, and it is still shown in a slight advantage in insurance rates. But ratings are now being adjusted logically to design rather than to material, it being recognized that the frame, if strong enough to support the vertical load, will perform its function whether of steel or reinforced concrete; and in either case it cannot furnish the required rigidity. That must be supplied by the walls and floors, tied together as a coherent unit.

Cleveland Begins Census of Real Property

Inventory of real property will include counts of existing buildings, occupancy, vacancy, doubling, new construction, lots plotted, deeds, mortgages, foreclosures and movements of population

AT THE first meeting of the committee on realty finance of the National Conference on Construction a subcommittee was authorized to cooperate with the committe on statistics in a study of local construction inventories, with particular reference to the provision of information in such inventories needed by financiers to enable them better to direct the financing of building. After several conferences a committee called the committee on real property inventory was set up in the city of Cleveland for raising the funds necessary for such a survey and for carrying out its technical details. On this committee are representative bankers, realty and construction interests, the United States postmaster, the county auditor and the agent of the Federal Reserve Bank. The bankers through the Cleveland Clearing House contributed a substantial sum on behalf of the financial interests, and commercial and other interests made contributions. A total of $15,000 was subscribed.

The staff work in connection with this study is under the direction of H. W. Green, president of the Cleveland chapter, American Statistical Association. The committee has described its purposes as follows:

To collect, classify, file and distribute basic and current information concerning real property and to indicate its degree of activity as reflected by transactions, construction, mortgage financing and occupancy, with allied studies of the trends of population. All studies and classifications of data are to be by census tracts and will be classified as to types of property, types of population, etc. The further purpose is to provide a perpetual inventory; the real property inventory will be a continuing activity and not a sporadic survey. The following working schedule has been developed as a basis for its operations:

Existing Property—All properties are to be counted and classified as to their various types—as, for example, single houses, two-family houses, apartment-house suites, storerooms, office room, etc. This is to be done by the post office. The county auditor will supplement this information from data in his tax files.

Occupancy-Vacancy—The post office will also count the vacancies once or twice each year. Forms are to be provided which will make it easy for the carriers to assemble the data in a classified way so that it can be quickly and inexpensively tabulated in Mr. Green's office. The information secured will also be checked and supplemented by the reports from the movers and by reports on the installations and removal of meters by the public utilities. Vacancies will be classified by type of property and location in the same manner as the inventory.

Doubling — Doubling - up indicates changing social and economic conditions and is the cause of abnormal vacancy. It gives an indication of the demand that may be expected upon resumption of employment. It will be counted by the post office in connection with the vacancy survey.

Construction—Detailed facts on new construction, major alterations and demolitions, indicating the net change in construction conditions, the type of properties and the localities that are active, will be secured. The information will come from the offices of the various building commissioners and from Dodge reports.

Lots Plotted—The location and degree of sublot activity will be indicated by the plotting of lots. This information will come ready for tabulation from the *Daily Legal News* and the county auditor.

Deeds—The market activity for property will be indicated by the number of transactions in the various parts of the city. This information will be furnished ready for classification as to type of property and location by the publishers of the *Daily Legal News.*

Mortgages—Information will be assembled on the amount and sources of new mortgage money and the type and location of property mortgaged, as well as on the cancellation of mortgages and on foreclosures. This information will come ready for tabulation from the *Daily Legal News,* and the Foreclosure Completion Co.

Foreclosures—Records will be secured monthly on foreclosures, types of property, value and location, as an indication of relative stability and economic ability.

Movements of Population—A record of the moves and shifts of population and business will be indicated by a record of the movement of household and commercial goods. The several trade associations and agencies contacting this phase of the community will cooperate in making reports at regular intervals. From these data will be shown the movement from one section of the city to another. In addition, these data will indicate the doubling and undoubling processes of families as well as businesses. Ultimately, it will also be organized so as to indicate movements into and out of the city with reference to family groups, commercial and industrial organizations. It will be a controlled check upon vacancy information.

Construction and the Relief Act

A review of the opposition to construction in 1931—The Relief Act and its importance to business revival

By Malcolm Pirnie
Consulting Engineer, New York City

Extracts from an address before the governor's conference of Indiana mayors to discuss trade recovery, held at Indianapolis, Oct. 13, 1932.

WHY WERE one and one-half billion dollars provided in the Emergency Relief and Construction Act for loans to states, municipalities and public agencies for self-liquidating projects? It was because Congress and the President were convinced that there was need throughout the nation for this volume of construction of self-supporting public facilities; that *the execution of this work would give employment directly to nearly half a million men and indirectly to a million more;* and that the re-creation of purchasing power through a permanent addition to the public wealth without increasing taxes would be a substantial aid to trade recovery.

There can be no doubt that our government has placed in the hands of each of our communities a keen-edged weapon with which to fight the depression, relying upon its simultaneous use by all of our cities and towns to help turn the tide of battle. If we are worthy of our trust, we shall pour these billion and a half dollars rapidly into the dry channels of trade in the form of wages to the re-employed.

Contrast this opportunity with the demoralizing effects of a dole. Funds for the dole must be obtained by taxes and donations, which subtract 100 per cent of the amount collected from the dwindling purchasing power of our people. The recipient of a dole is always fearful of its discontinuance and will not purchase other than the bare necessaries of life. He has no credit and promotes the lack of confidence in business that must be eliminated before recovery can be effected. His self-esteem is tortured into blind resentment in the public marketplace. His future ambition and usefulness as a citizen are burned to ashes before our eyes. He wants a job, not a hand-out.

When normal banking channels refused credit to our communities, each of us had a reason for denying work to our fellow citizens. This excuse was removed by the passage of the Emergency Relief and Construction Act. Today each of us is responsible for the continued enforced idleness of his neighbor.

Contrary to general belief, public-works construction as a whole, including federal public works, was not speeded up in 1930 to combat the depression. Owners of real property began to emerge from frenzied studies to reduce overhead charges with the realization that taxes constitute a substantial charge prior to interest on first-mortgage bonds, and that unless taxes could be materially reduced interest on many first-mortgage bonds would soon be in default. Out of such thoughts grew a nation-wide propaganda, painting in vivid colors alleged gross extravagance of state, county and municipal governments and calling upon them to reduce expenses. Without weighing consequences, officials of local governments were urged or ordered to stop the planning of public improvements.

Thus, in the summer of 1931, when legislation was being formulated to lend federal credit to build new piers under the sinking foundations of banks, insurance companies and railroads, the leaders and representatives of these same interests were uniting to stop the construction of new public facilities and adequate maintenance of existing public works. Arguments were met with the accusation that our cities, counties and states had been on a drunken orgy of spending which had increased taxes beyond the ability of the taxpayer to pay, and with the determination to reduce governmental organizations and stop expenditures for public works. Unemployment, resulting from the wholesale discharge of employees of private enterprises, was rapidly increased by dismissing many government employees engaged in public works throughout the country.

In many cases this was the first supposed economy effected by local governments. It did not reduce taxes to throw a million and a half men out of employment so they could not pay rent or taxes or buy food and clothing. Taxes had to be collected from those who could pay, not only to meet the unaltered fixed costs of government services but also the unproductive costs of unemployment relief. Nothing could have been less intelligent under the circumstances.

So thoroughly had business men become convinced that public expenditures must cease in order to reduce taxes that it was futile to argue economic principles with them. The laborer digging a sewer trench was to them a symbol of increased taxes instead of a purchaser of commodities they needed to sell in order to pay taxes past due. It was due to realization of such misguided public opinion that efforts to rejuvenate general public-works construction were abandoned, and a concerted drive was made to recapture public approval for construction of such public facilities as could be supported by charges collected from all individuals benefited. Such works were termed "self-liquidating public works" to distinguish them from public works entirely supported from the general tax fund.

Public-works construction was almost annihilated at the close of 1931. The reason given for failure of investment banking support was that these agencies had determined to lend no more money to municipalities for construction work. This is clearly stated in the resolution adopted by the Board of Governors of the Investment Bankers Association of America at its mid-winter meeting Jan. 30, 1932, as follows:

> Resolved: That the Board of Governors of the Investment Bankers Association of America is opposed to the extension of public improvements which would necessitate an increase in the bonded indebtedness of states and municipalities under present conditions, and that public officials be urged to adopt programs of strict economy, adjust expenditures to actual income, and restrict the incurrence of bonded indebtedness to the end that taxation may be reduced and credit maintained.

Securing of federal credit for self-liquidating public works was the only hope remaining for financing any municipal construction work in 1932.

The American Society of Civil Engineers entered the battle officially to revive "public-works construction as the most effective immediate means of increasing purchasing power, stimulating trade recovery and reviving employment." This made possible an alliance of the public-works construction industry and engineers and the housing industries and architects, the latter representing a substantial proportion of private construction interests. Sponsored by the Construction League of America, the National Committee for Trade Recovery was formed, and it carried to Washington the sound economic principles that had welded together the directors of at least 20 per cent of the nation's normal business. Their efforts aided materially in the passage of the Emergency Relief and Construction Act, extending federal credit to states and their political subdivisions for the construction of public works which meet the specifications of the act.

The act was signed by President Hoover on July 21, 1932. Almost immediately the city of Pasadena, Calif., applied for a $6,000,000 loan to build its needed additional water supply. Before negotiations could be fairly started, however, the funds were obtained from private banking sources at close to 4 per cent interest.

Administration of the Relief Act will be adjusted to meet the needs and financial practices of applicants, provided they are sound. To secure the broadest possible adjustment, therefore, it is essential to apply immediately for all needed loans so that all problems of individual communities may be considered in shaping future policies of administration of the act.

The present-day defeatists' demand for return to the "good old days" of low tax rates, when water was drawn from the well and wastes were allowed to remain upon the properties where they originated, is impossible of accomplishment. Our citizens will not countenance a material reduction in present standards of living but are constantly demanding improvements. They want clear, sparkling, colorless water, free from objectionable tastes and odors at all times, and are no longer satisfied with the knowledge that the water is safe. They are demanding that pollution be removed from our rivers. They want constantly improved communication over smooth, hard-surfaced roads. They know they can produce more than the country as a whole can consume by working eight hours each day, and they want shorter work days and parks and playgrounds in which to pass their leisure hours. In these circumstances public services provided by the government are bound to increase, and no temporary obstacles placed in the way of construction of public works can reverse the trend.

It is good business to construct all works that are needed now at present low prices. This will reduce the average cost of our public facilities and go far in promoting re-employment and trade recovery. None of us can afford to delay any of the needed public-works construction that can be started now.

Letters to the Editor

Experience With Goldbeck Cells

Sir—Dr. Terzaghi's article in your Sept. 29 issue, on "Record Earth-Pressure Testing Machine," is of unusual interest to me, primarily because the so-called Goldbeck pressure cell was used as an auxiliary pressure-measuring apparatus. The statement is made that this cell was found to be "utterly unreliable" and that "the cell readings for earth pressure were so erratic that no reliable results were secured."

I am not informed as to just why the cell readings are considered unreliable, but I presume that identical readings were not secured from cells which theoretically might have been expected to read alike. I wonder if such differences in pressure did not, in fact, exist, and if the so-called erratic readings do not actually represent the true pressures in different spots in the bin.

After the development of the pressure cell at the U.S. Bureau of Public Roads I did a lot of work with it personally in taking pressure measurements at the bottom of a bin constructed at Arlington Farm. This bin was 14 ft. long and 7½ ft. wide, and heights of fill up to 5 ft. were used. Fifteen cells were installed in the extremely rigid reinforced-concrete floor of the bin. I found that these cells frequently did not give identical readings, and we soon discovered that this was due to the non-homogeneity of the filling material. It is a most difficult matter to place an earthfill so as to obtain uniformity of compaction throughout, and this results in variable pressures. Greater care in placing the fill resulted in more nearly identical readings.

Another matter may be important in its effect on the cell readings—namely, the warping or bending of the retaining wall containing the cells, either under load or due to temperature. Slight movements of the wall may have a great effect on the pressures exerted by the fill. In the cell the only movement required for taking readings is that necessary to break electrical contact, generally ranging up to not more than 0.0002 in. By a special apparatus the movement of the weighing face of the cell has been measured while the cell was subjected to variable earth pressures. (See *Public Roads*, August, 1920). We found that at a pressure of about 17 lb. per sq.in. electrical contact was broken with a movement of 0.00018 in., and for smaller pressures smaller motions were required. We found that these extremely small motions were accompanied by a change in pressure of about 0.1 lb. per sq.in., and we concluded that this was a close approximation to the error in the cell reading, and I was convinced that the cell readings were reliable. I have yet to see any test data that prove otherwise. I believe that if the cells show high and low readings where identical readings might be expected, high and low pressures actually exist.

Inexpert manipulation, due principally to allowing the cell pressure to exceed that required for equilibration, may readily cause serious error. Inaccurate workmanship in the manufacture of the cell has likewise caused trouble. Attempts to use this device for purposes for which it was not intended have resulted in disappointment. Furthermore, the lack of homogeneity of earthfills is not always realized; and if average pressures are desired a sufficiently large number of readings in different locations must be secured. Instead of giving unreliable results in the bin described by Dr. Terzaghi, I wonder if the pressure cells are not actually giving extremely valuable results, showing the wide range of pressures that exist in an artifically compacted earthfill.

A. T. Goldbeck,
Director, Bureau of Engineering,
National Crushed Stone Association.
Washington, D. C.,
Oct. 6, 1932.

Causes of Depression

Sir—In your issue of Sept. 29, p. 385, Ralph W. Powell quotes Professor John Dewey with approval, as follows.

> But meanwhile, the mass of the population is not receiving, because of private control of the sources of production and exchange, the means which will enable them to buy what the plants are producing.

Presumably the meaning is that private control of the plants is depriving the mass of its means. But if that were true, would it not follow that the plants would be receiving more than they disburse, and hence would be striving to give employment? On the contrary, it seems to be true that the plants receive less than they give and thus first lose their profits and then are forced to dismiss their employees.

It would be interesting to be informed why *private* control of the sources of production and exchange would operate differently from *other* control. How would any other than private control relieve us of rising and falling prices, beneficient in ultimately reducing prices and thus relieving poverty, and yet when controlled by collective action apparently causing depression?

Admittedly, the recession of prices can be prevented by inflation of currency. But such control is only for the average of all prices. Individual prices would still fluctuate about the average base. Higher prices mean more poverty. It is doubtful if *collective* control of prices could prevent depression except by inflation, controlled to cause prices to rise. This is the method being used by Russia.

The desirable condition for the relief of poverty is for wages to rise and for prices to fall. But since wages constitute the major part of prices, they must to some extent move together. (The only feasible way for both to move together, and at the same time to have wages rise and prices fall, is by frequent fluctuations.) This is the method that private-ownership capitalism has employed. It is the control of this method by collective action that causes depressions.

Daniel B. Luten.
Indianapolis, Ind.,
Oct. 6, 1932.

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One Sign of Convalescence

AMONG the cheering happenings of the season is the encouraging progress of construction contract lettings. The volume of awards is holding up distinctly above the seasonal rate line; if anything it has shown a rising tendency in recent weeks, although normally a decrease would be expected in the fourth quarter. The phenomenon is quite independent of R.F.C. construction loans, for no contract awards have yet been reported under these loans. Naturally, the reported lettings include much public-works construction, but not all of this is due to governmental stimulation; aside from federal building contracts and the initiation of road work made possible by the emergency fund included in the Relief Act, there is welcome evidence of a trend toward resumption of normal public construction by local governments. In addition, rising private construction shows signs of new enterprise on the part of industries and individuals, a still more encouraging development. Considering the basic relation of construction to manufacture and trade, the current activity in the construction field indicates that economic convalescence is in progress.

Making a Low Bid Pay

THE METHODS used in building the Wards Island sewage-treatment plant afford an instructive example of cost-saving construction planning and coordination. Intense competition in bidding for the work forced the contractor to an abnormally low price; to keep his costs within this price he then planned for a construction speed far in excess of that specified in the contract schedule, and has realized it. Discarding accepted procedure in large sewage-plant building, he started afresh in job planning. An ingenious arrangement of fixed, portable and elevating belt conveyor units was the answer to the requirement of distributing over 100,000 cu.yd. of concrete to be placed in thin walls extending over a 30-acre site. A central mixing plant with specially-designed handling equipment, ingenious form design, and simplified methods of placing 7,000 tons of steel bars, complete the concreting picture. The multitude of miscellaneous items essential to operations of this class was skillfully worked into the construction plan without disturbing the all-important steady flow of concrete. Ultra-modern equipment ably utilized by shrewd construction planning is the key to the Wards Island operation.

Salaries in Public Service

TAXOPHOBIA, the ailment from which the American people have been suffering for the past few years, has developed a new symptom. The thought is now becoming current that the salaries of those in public service are unreasonably high, having not been subjected to the same degree of "adjustment" as the salaries of corresponding positions in business. Concerning the salaries of government lawyers, policemen, school teachers and letter carriers we are not prepared to speak, but as far as engineers are concerned the new belief can be classed as an unfortunate delusion. During the happier years of recent memory salaries paid to engineers in public employ were notoriously low, never high enough to compete directly with those offered by commercial establishments. Today, with all the reductions brought about by private firms, public service is just approaching a condition of relative equality in the matter of compensation for the rank and file of engineering employment. And in the positions of higher responsibility, public service still remains *economically* unstimulating as compared with commercial activity. The work done by such men, as the engineer directing construction for a large city or heading the technical service of a major state or federal department, work carried sometimes beyond the limits of physical endurance, merits warm gratitude rather than the peevish complaints of the public at large.

Doubtful Economy

THE TAX-REDUCTION complex manifests itself not only in determined pay-cutting efforts but also in opposition to necessary public improvements. A typical instance of the latter is the attempt to stop three important New York projects: equipping the essential feeder sections of the new subway system, which are all but ready for opening; completing the Triborough bridge, whose substructure is ready for towers and cables; and building the Midtown tunnel of the Port Authority. The situation is clearest as to the subway and bridge, for here the construction is necessary to vitalize the large investment now lying idle. Although that investment already burdens the taxpayer with large interest charges, the remaining expenditure necessary to make them produce income is stubbornly opposed, and even the plan of having the Triborough bridge completed with R.F.C. money as a toll project is attacked. Opposition to the tunnel, while of more complex kind, also rests largely on arguments of momentary economy. Other cities offer similar illustrations of hostility to continuance of public-improvement work. While controversies over useful expenditures go on, appropriations and drives for charity relief become ever more numerous. In the end the taxpayer is likely to find that he has not saved a dollar of total outgo and in addition has lost the income that would have resulted from the construction he opposed.

Against Flying Signs

SIGNS and bill boards have acquired an unsavory reputation in some localities because of their tendency to become death-dealing kites in wind storms. In general this stigma does not attach to large display signs, which are usually designed and erected under engineering supervision, but the potential hazard is present even in these structures. Ultra-conservatism should, therefore, be the first consideration of every sign-frame designer, as is evident from the review of good practice in sign design outlined on another page of this issue. The most compelling argument for using high wind loads, low unit stresses and simple, sturdy framework is the

fact that signs are so often subject to unsupervised alteration. A wrench, a ginpole, and two or three mechanics can in a few minutes destroy the safety that hours of careful calculation have put into a sign frame. Foolproof signs are better than flying signs. They may cost more, but they are worth more.

Earthquake Safety

FOR sound dollars-and-cents reasons the engineers of the West Coast have been studying earthquake-resistant construction attentively for some years past. The fatalistic attitude of former ages toward earthquake destruction—such an attitude as many still hold toward the tornado hazard—has long since disappeared, and experience in numerous earthquakes has taught that the ideal of structural security under even severe shock can be measurably approached. It is now well recognized that public and private interest alike call for developing practical means of attaining full security in major structures and in public services. This recognition is the motive of the studies in question. It is also the reason why great value resides in Prof. Bailey Willis' illuminating statement of the two basic principles that have evolved.

In 1906 the San Francisco earthquake proved that well-constructed buildings of that day were not far from being able to resist a violent shock. This conclusion was more fully appreciated when due thought was given to the nearness of the focus—the San Andreas fault is only a few miles from the city. In that earthquake, also, large engineering structures proved highly resistant; the Crystal Springs concrete dam, only a few thousand feet from the line of the fault, was not injured, and earth dams directly over the fault continued in service even though sheared. Nearly two decades later the Tokyo earthquake repeated the same lesson; the major buildings there were more strongly constructed, but the shock was more violent. A wide gap remains between this near-resistance and complete security, but the gap is being closed.

The first principle stated by Professor Willis, that a structure must be a unit tied together in all its parts against the possibility of dislocation, has been recognized in one form or another for generations. It was applied, for example, by the old-time builders who encircled their buildings with rods or chains. In the form given to it by Professor Willis it is clear and of widest application; when properly understood and utilized it can serve as a safeguard not only against the shaking down of masonry walls and parapets but also against the rending apart of sections of a structure as happened in the San Marcos building which figured in the Santa Barbara catastrophe seven years ago. How the principle should be applied in practice will always be a problem for the engineer in each individual case, and by no means an easy problem; but the general objective, at least, is so clearly marked out by Prof. Willis' statement as to be unmistakable.

Bonding and anchorage are primary matters in attaining structural unity, of course. But unity requires also the adjustment of rigidities as between the entire structure and its several parts, so that a tower or finial, for example, cannot get into independent oscillation. This is among the difficult elements of the practical application.

The second principle calls for high rigidity, or in other words a short inherent period of oscillation of the structure. It finds its strongest justification in the showing made by low and massive buildings in severe earthquakes, for such structures, with short inherent period, have come through severe shocks unscathed whenever they were adquately bonded to assure structural unity. High buildings violate the requirement of rigidity, and doubtless the height limit imposed by the Japanese rules for construction was fixed in recognition of this fact. The combination of rigid superstructure with a flexible foundation story described by Professor Willis in its application to the Olympic Club building is in theory an ideal solution, and one that should prove practically satisfactory if sufficient range of movement is provided for and if care is taken that the movement does not create hazardous local destruction.

Aside from buildings, engineering structures such as bridges and dams have been the subject of much thought with respect to earthquake protection during the past four or five years; the Carquinez Straits bridge, the Suisun Bay railway bridge and the Pine Canyon dam are examples. The same two principles that apply to buildings will often be safe guides in this field also, but probably a broader view of earthquake possibilities will need to be taken in many cases. The earthquake brake used on the Carquinez Straits bridge suggests the special problems that may arise. High towers will raise questions as to the conditions under which a flexible structure can be made secure without converting it into one of high rigidity. The requirements of practice, in short, extend far beyond present knowledge, and there is a wide field for further study and engineering development. The principles now established constitute a firm foundation for this future work.

Cleveland Takes Stock

PROPERTY inventories such as that in progress at Cleveland represent the most definite approach yet attempted to fundamental questions of city growth and stability of values on which planned construction requires to be based. Indeed it is somewhat idle to talk of efficient planning of construction until much more definite knowledge of city growth and decay is available to property interests and city public works officials.

The investor must know the current trends in population, in business movement, in growth and obsolescence, property occupancy and vacancy, if he is to place his money profitably. The public-works official has as much need of this information if he is to budget improvement expenditures wisely. The Cleveland survey and census undertakes to provide such knowledge as fully as is now possible. It is particularly deserving of scrutiny as to the kinds of information being secured and the means employed to secure them.

While the inventory will promote understanding of how investment and construction are related to community changes, much greater gain is assured when other cities follow the lead of Cleveland. The obstacles in ways and means and costs are small; only the inspiration and energy to start require to be aroused. Every city that undertakes such a survey is certain to obtain better guidance in building practice, investment control, budgeting public improvements, and adjusting taxes to the best interests of all.

NEWS OF THE WEEK

Smoke and Noise Receive Attention at A.P.H.A. Meeting

THE newer fields of environmental improvement, including atmospheric sanitation and noise abatement, were stressed at the recent meeting of the Public Health Engineering Section of the American Public Health Association in Washington, D. C., Oct. 24-27, 1932. In addition, discussion was held on the progress being made in the fields of garbage incineration, street cleaning and the disposal of beet sugar wastes. The Conference of State Sanitary Engineers held its annual meeting immediately preceding the convention of the A.P.H.A. and held one joint meeting with the Public Health Engineering Section.

Utility expansion needed

The state sanitary engineers made overtures to the engineering advisory board of the Reconstruction Finance Corp. to urge upon that body the importance of giving favorable consideration to public utilities, such as waterworks and sewerage improvements, that are in the interest of public health and sanitation. The conference designated W. L. Stevenson, chief engineer of the Pennsylvania State Department of Public Health, as its representative in matter relating to the R.F.C.

The major portion of the engineers' meeting was devoted to discussion of standard practices for the design of small sewage disposal devices for individual homes or small groups of homes, for mosquito eradication, for protection of milk supplies, for sanitary supervision over bathing places and industrial hygiene.

Air conditioning

A joint session of the Public Health Engineering Section and the Industrial Hygiene Section of the A.P.H.A. was devoted to air sanitation and air conditioning. Papers by Haven Emerson, of New York, N. Y., and Fred O. Tonney, of Chicago, Ill., maintained that there was a positive hygienic reason for the abatement of atmospheric pollution by smoke because statistical evidence relates prevalence of rickets to deficiency of sunshine. Dr. Tonney asserted that the abatement of this evil was a problem for the engineer. He further maintained that once clean air is accepted as a human necessity, it will become an economic demand. In a paper entitled "Smoke Abatement at Low Cost," Morris M. Cohn, of Schenectady, N. Y., described an effective utilization of the fire department for the continuous systematic detection of violations of the city smoke ordinance. He stated that effective detection is impossible with only a few inspectors but with firemen standing watch at all times in districts with which they are familiar, few violations go undetected.

Edward P. Brown, director, Noise Abatement Commission, New York City, in

(Continued on p. 542)

General Sibert, Head of Board Advising on Hoover Dam, Resigns

Major Gen. William L. Sibert, who has been serving as chairman of the Colorado River advisory board of engineers, resigned from that position on Nov. 1. In resigning from the board Gen. Sibert gave as his reason the strenuousness of the board's work in connection with Hoover Dam. Gen. Sibert is 72 years old.

The engineering advisory board was appointed by the Secretary of the Interior in July, 1928. It consisted of Major Gen. William L. Sibert (retired), Daniel W. Mead, Robert Ridgway, Charles P. Berkey and W. J. Mead.

Suit to Stop Aqueduct Loan To Be Heard in Washington

A suit brought by some citizens of California to stop the Reconstruction Finance Corp. from bidding on $40,000,000 of bonds of the Metropolitan Water District of Southern California is to be heard by the supreme court of the District of Columbia on Nov. 3. Making of a loan to the water district for the construction of the Colorado River aqueduct is opposed on the ground that the aqueduct project is not self-liquidating in character but is dependent upon taxation for financing. The petition of the interveners holds that taxes may have to be levied to pay interest and principal of the $220,000,000 of bonds required.

Many Large Contracts Approved for River and Harbor Work

Contract for the construction of a floodway and navigation channel along the West Shore of Lake Okeechobee in Florida and for construction of a levee along the lake was approved by Major General Lytle Brown, chief engineer, on Oct. 25. Contract has been let to the Spadaro Contracting Co., Inc., and George Colan & Co., New York, for $554,050. This contract was the largest one in a group of river and harbor contracts totalling over $3,000,000 approved by the Chief of Engineers on Oct. 25. Another large item was the contract for $311,190 to Merritt, Chapman & Scott Corp., New York, for the construction of a riprap jetty and an apron at the westerly end of Long Beach; $221,537 for the construction of the Vermillion locks in the first New Orleans district to J. DePuy of San Antonio, Texas; east bank levee work on the Mississippi River, $230,217 to the Arundel Corp. of Baltimore, and a contract of $310,140 to the McWilliams Dredging Co., New Orleans, for dredging the intracoastal waterway between St. Johns River and the Tolomato River in the Jacksonville district, Florida.

On Oct. 28 the chief of engineers approved the award of a contract of $294,750 to the Arundel Corp. of Baltimore for dredging in Craighall-cutoff angle in the channel leading to Baltimore.

Loans Totaling Over Ten Million Approved by R.F.C.

SEVEN self-liquidating projects were approved by the directors of the Reconstruction Finance Corporation on Oct. 31. They are: Hillside Housing Corp., New York City, $3,957,000; Hudson River bridge, Catskill, N. Y., $3,400,000; Maverick County Water Control District No. 1, Eagle Pass, Texas, $1,476,000; City of Bowling Green, Ky., $630,000; City of Hobart, Okla., $250,000; Wanakah Water Co., Hamburg, N. Y., $750,000; Madison Heights Sanitary District, Amherst County, Va., $62,500.

First housing project approved

The Hillside project provides for the construction of a complete neighborhood unit of low rental apartments to house 1,581 families. This is the first of the limited dividend housing projects to be acted upon by the R.F.C. It is estimated by the corporation that an average of 700 men will be employed on the project throughout the construction period of 11 months. Approximately 1,400 men will receive indirect employment for a like period through the purchase of materials and equipment to be used in building the units, which will be chiefly of the 4-story walk-up type with a few 6-story elevator type buildings. The buildings will have a total net volume of 12,450,000 cu.ft. and will contain 5,378 rooms. Maximum light and ventilation is being provided.

The project of the Hillside Corp. has been approved by the New York State Housing Board. That board has stated that the site selected is adjacent to localities in which congested and unsanitary conditions exist. Further, it is said, such conditions cannot be remedied through the ordinary operations of private enterprises so as to insure the construction of housing facilities in conformity with reasonable standards of health, sanitation and safety within the maximum rental rates for Bronx County prescribed in the New York State housing law.

Construction contract arranged

The loan requested of the R.F.C. is to be secured by the mortgage bonds of the Hillside Corp. and the amount is ⅔ of the total estimated cost of $5,936,217. The rate of interest will be 5 per cent, the maximum permitted by the New York State housing law, and the rate of amortization 3 per cent per annum of the amount of the loan plus in each year the saving in interest in that year resulting from the reduction in the amount of the loan in all prior years. Starrett Brothers and Eken, building contractors, are parties to the equity syndicate and the application to the R.F.C. provides that they are to be the general contractors on the project. It is understood that the contractors have guaranteed that the whole cost of con-

struction including builders and architect fees shall not exceed $5,222,300. The contractors propose to take competitive bids on all branches of the work, such bids being subject to review by the housing board and by the R.F.C. The land involved, which is bounded by the Boston Post Road, Rick St., 213th St., and Eastchester Road, has an area of 697,313 sq.ft.; it is now owned by Senator Nathan Straus, Jr., a member of the equity syndicate. The plot is approximately 540 x 1,300 ft. A central feature of the development will be a 2½ acre playground.

New York is the only state with a regulatory housing law now in operation and for this reason is the only state eligible at the present to apply for loans under the terms of the Relief Act. Ohio has recently passed a law which will take effect on Jan. 1 of next year. Several other states, it is understood, are planning legislative action looking toward construction of similar projects.

The terms on which the loan was approved by the R.F.C. are in some respects different from those set forth in the application of the Hillside Housing Corp. to the New York State Housing Board. These changes must be approved by the board before any advance can be made by the R.F.C.

Irrigation in Texas

The R.F.C. has agreed to purchase $1,476,000 bonds of the Maverick County Water Control District No. 1, bearing interest at the rate of 6 per cent. The bonds are to mature in varying amounts between the years 1933 and 1970. The money will be used for work on combined irrigation and power project described in *Engineering News-Record* Aug. 11, p. 153 and Sept. 29, p. 377. Most of the $1,476,000 will be expended for labor. It is estimated by the corporation that 2,700 men will be employed for 18 months.

The project in its entirety embraces the construction of a canal 92 miles long of which 32 miles already have been completed. Laterals from the canal will provide complete irrigation for 15,000 acres of land lying between the canal and the river. A hydro-electric power station already has been constructed. Beyond it the canal has yet to be built to irrigate 45,000 acres of land for a distance of 60 miles downstream.

A flood in September of this year damaged about 15 miles of the canal and forced the power plant to shut down. Repairs will be made including construction work of a nature to prevent similar flood damage in the future.

As a condition of the loan, the applicant is required to procure subordination of the lien of $2,709,000 of bonds now outstanding in private hands.

Sewer system for Bowling Green

The Bowling Green project involves the purchase of $630,000 bonds of the city to yield 5½ per cent. The money, to be used in constructing a new city sewer system, is to be repaid in annual installments between the years 1935 and 1972, inclusive. Householders of the city are to pay monthly charges for the sewage service. The project embraces the construction of a system of sanitary sewers for collection and disposal of sewage. For the present, sewage is to be discharged into underground streams. A sewage disposal plant will be constructed later. The plan has the approval of the state board of health.

Employment on the project will be created for 160 men for the first month, increasing to more than 600 in the fifth month.

Water supply at Hobart

The R.F.C. is to purchase $250,000 bonds of the city of Hobart, Okla., to bear interest at the rate of 6 per cent. The loan is to be repaid $12,000 each year for the years 1938 to 1957 inclusive. The money will be used to construct an earth dam for the impounding of 800 million gallons of water for the city and an 8-mile gravity pipe line. It is estimated that $85,000 will be expended in building the dam, $112,000 for the gravity and distribution pipe lines and $40,000 for lands, rights of way and incidentals.

Employment will be provided direct on the project for 220 men for five months based on a 30-hour work week.

Water for Buffalo suburb

The Wanakah water project involves the purchase of $70,000 in bonds to bear interest at the rate of 6 per cent to be purchased at 90. The loan is to be repaid in semi-annual installments. The money will be used to extend the water company's system. It is estimated that 100 men will be employed for 75 days.

The extension of the company's distribution system will provide fire protection and water to a suburban section of Buffalo located in the town of Hamburg, 12 miles south of Buffalo. This section consists largely of summer homes on the shore of Lake Erie and owing to the fact that these houses are unoccupied a part of the year, the fire protection afforded by the new pipe line will effect an unusually large reduction in fire insurance rates.

The Madison Heights Sanitary District project involves the purchase of $62,500 in bonds bearing interest at the rate of 6 per cent, to be issued by Amherst County, Virginia. The money will be used to construct a water supply system including intake, pumping and filtration works and distribution piping. The district now has no public water supply nor fire protection.

Hudson River bridge at Catskill

The R.F.C. directors tentatively agreed to purchase $3,400,000 bonds of the New York State Bridge Authority, bearing interest at the rate of 5 per cent, to be repaid in ten equal annual installments beginning in 1935, the money to be used to build a highway toll bridge across the Hudson River at Catskill, midway between Poughkeepsie and Albany. The agreement is conditional upon enactment by the state legislature of certain amendments to the statute authorizing the construction of the bridge. The bridge will be a cantilever and suspended-span type structure, providing for a main channel span of 800 ft. The overall length will be 4,823 ft. The bridge roadway will be 30 ft. with an additional 5 ft. for a pedestrian walk. The vertical clearance above high water will be 142 ft.

Building of the bridge will create employment for about 750 men for 18 months, some working direct on the site and others in mills and shops supplying materials and equipment. About 12,000 tons of steel, 36,000 cu.yd. of concrete, 35,000 ft. of concrete piling and 1,740 cu.yd. of stone masonary will be used.

Robert Ridgway Honored

Robert Ridgway, who retired on Nov. 1 as chief engineer of the Board of Transportation of New York City, was the guest of honor at a dinner held at the Engineers Club, New York, on Oct. 31. Over one hundred engineers, contractors and officials of the city's transit systems attended the dinner.

Mr. Ridgway has been retained by the Board of Transportation as consulting engineer.

Rail Line to Coast Proposed

Promoters of an 800-mile railroad from Denver, Colo., to San Pedro harbor, Calif., will get a hearing Nov. 22 before the California Railroad Commission at Los Angeles. The application was filed several months ago with the Interstate Commerce Commission in the name of the Denver Pacific Railroad, a new corporation organized under Delaware laws. The project would be financed by offering the stock and bonds of the company for popular subscription.

Two Railroads Combine to Build Union Terminal at Atlantic City

Construction of a union terminal at Atlantic City and consolidation of the separate railway services now maintained between Atlantic City and Philadelphia is to come about through an agreement reported to have been reached late in October between the Pennsylvania Railroad and the Reading Railroad. All the details of the plan have not yet been worked out but in general it will provide for the construction of a $5,000,000 terminal for joint use at Atlantic City, consolidation of operations between Atlantic City and Camden, N. J., with line improvements and grade separations at major highways and possibly electrification of the joint line and entry into Philadelphia over the Philadelphia-Camden bridge. At present the Pennsylvania crosses the river above Philadelphia and enters by a roundabout route and the Reading reaches the city through a ferry service.

Large Hydro-Electric Plant in Virginia Authorized

A permit to begin construction on a $12,000,000 hydro-electric plant on the New River in Pulaski County near Radford, Va., has been granted to the Appalachian Electric Power Co. by the State Corporation Commission. The permit requires work to start within 12 months and be completed within three years. Recently the Federal Power Commission reaffirmed its declaration that the portion of the New River upon which this plant is to be located is navigable under the terms of the federal power act. The finding is now before the federal district court, western district of Virginia. If the commission is upheld final authority to grant a permit for the construction of the projected plant will rest with the Federal Power Commission.

The proposed dam will be about 1,100 ft. long, of which 450 ft. will be a concrete spillway section. It will form a reservoir 21 miles long having a usable storage of about 206,000 acre-ft.

Red River Bridge Work Resumed

Work on the Red River bridge at Shrevesport, La., is to be resumed through the use of workers provided by the state unemployment relief agencies disbursing federal funds, according to an announcement made recently by the highway commission. Workers are to be furnished through local placement bureaus and their wages of $1.50 per day are to be charged to the relief fund.

John Fritz Medal Awarded to Daniel Cowan Jackling

Award of the John Fritz gold medal for the year 1932 is to be made to Daniel Cowan Jackling of San Francisco in recognition of his pioneer work in the extraction of copper from low-grade ore. The award is made by a board of sixteen members appointed by the four national engineering societies. The medal was established in 1902 by professional associates and friends of the late John Fritz to perpetuate the memory of his achievements in industrial progress.

Distinguished civil engineers who have received the medal are J. Waldo Smith, George W. Goethals, John F. Stevens and Ralph Modjeski.

Competition in Transportation To Be Subject of Study

Two committees to study the problems of competing forms of transportation have been appointed within the last few days. One is a committee of the Chamber of Commerce of the United States, and the other is a committee representing the National Highway Users Conference and the American Railway Association.

The committee appointed by the U. S. Chamber of Commerce is entitled the "Special Committee on Competing Forms of Transportation." Its purpose is to make a searching inquiry into developments and changes that have taken place in the transportation field in recent years. It will go into the shifts in competition brought about by the newer forms of transportation—motor vehicles, pipe lines and airplanes—and the effect they are having on older forms. It also will consider such matters as the regulation of rates of water carriers through the Panama Canal, regulation of rates and services of bus and truck transportation, and whether taxes, tolls and license fees paid by these different agencies are on a fair and equitable footing.

This committee will take up current problems of the national transportation system at a point where the Chamber of Commerce Railroad Committee left off. Recently the latter committee made a group of recommendations to the Chamber as to needed railroad regulations but most of it dealt largely with problems bearing exclusively on the railroads.

The joint highway-railway committee appointed by the National Highway Users Conference and the American Railway Assoication will draft a program of uniform state and federal legislation for the elimination of the elements of dissatisfaction heretofore prevailing in the transport situation. It will be expected to determine also what should constitute fair regulation of both rail and highway transportation in the future.

Money Allotted for Work on Rivers and Harbors

Allotments of funds for river and harbor work provided under the Emergency Relief and Construction Act, in addition to those previously published (*ENR*, Sept. 22, 1932, p. 361), were announced by the War Department on Oct. 28. The new allotments are as follows: Missouri River, Kansas City to the mouth, $300,000; intracoastal waterway, Jacksonville to Miami, Fla., Lake Worth section, $200,000; Niagara River, $500,000; Green and Barren rivers and Bare Creek, Ky., for locks and dam construction, $970,000.

In addition to the allotments noted herewith and in our issue of Sept. 22, the Secretary of War on Sept. 19 approved an allotment of $65,000 for lock walls in the Ohio River in the Huntington, W. Va., district and $795,000 for dredging in the Detroit River.

These allotments under the Relief Act are subject to the limitations of the act as to labor.

Development Work to Be Started at Port Isabel, Texas

Bids for the dredging of a channel from deep water in the Gulf of Mexico to Port Isabel, Texas, a distance of 4.4 miles are to be opened at the U. S. District Engineer's office in Galveston Nov. 19. Start of the dredging work will mark the culmination of over 14 years of effort on the part of the people of the lower Rio Grande Valley for the re-establishment of Port Isabel as a transportation center. Before railroad lines reached the lower Rio Grande Valley, it was an important center for the movement of freight in and out of south Texas and northeast Mexico. A narrow-gage railway owned by a Spanish company connected the town with Brownsville.

The federal government will dredge a 25-ft. channel and the Port Isabel-San Benito Navigation District will contribute $450,000 to the cost of the work.

Street Widening at Detroit Urged for Relief Work

Efforts to speed work on the widening of Woodward Ave. in Detroit from Grand Circus Park to Grand Boulevard to provide winter work for unemployed men are being made by the Detroit City Council. The plan as put up to the 151 property owners involved is that they agree to commencement of the widening work at once, they to be paid through the proceeds of a joint city-state loan of the Reconstruction Finance Corp. Pending payment of awards in full by the R.F.C., the state, or the city, interest will be allowed on unpaid awards.

In addition to the Woodward Ave. work which it is hoped to put under way immediately, the council is considering a still broader project to include widening of Gratiot, Michigan, Grand River and Van Dyke avenues at a total cost of $28,000,000. The Woodward Ave. work is estimated to cost about $11,000,000. Of this amount, $1,000,000 would go for actual physical widening, $2,000,000 for damages to property, and $8,000,000 for land. The property damage money would probably be spent immediately for reconstruction work.

Niagara River to Be Deepened

Plans for deepening the east channel of the Niagara River from North Tonawanda to Niagara Falls at a cost of $500,000 are being completed in the district engineer's office at Niagara Falls. Water-borne commerce now reaches Niagara Falls through the west channel. The east channel provides a much shorter route. It is expected that bids can be called in time to start the work in the spring.

Few Applications Recorded for Loans from R.F.C.

Few new applications for loans from the Reconstruction Finance Corporation were reported during the past week.

Wellsville, Ohio, plans to make application to the R.F.C. for a loan with which to build two dams to supplement the city's water supply system. An engineer has been engaged to make the necessary preliminary studies.

That the town of Belleville, Ill., has applied to the R.F.C. for a loan of $180,000 for the construction of a municipal water plant has been emphatically denied by Mayor Brechnitz.

Application for funds with which to build a toll bridge across the Missouri River between Platte County, Mo., and Wyandotte County in Kansas, has been made by the Regional Bridge Co., Kansas City, Kansas.

A loan for the construction of part of the San Francisco-Santa Cruz ocean shore highway is proposed by Joint Highway District No. 9 made up of the counties of San Francisco, San Mateo and Santa Cruz. The district has sufficient funds to purchase right-of-way and plans to apply to the R.F.C. for a loan of $250,000.

Paducah, Ky., has applied to the R.F.C. for a loan of $65,000 for the construction of a river terminal there.

Jasper, Ala., has made application to the R.F.C. for a loan of $50,000 for the construction of a sewage disposal plant and $80,000 for laying 9 miles of pipe line to the Warrior River for water. A bill to permit financing of sewage disposal through service charges is now before the Alabama legislature.

The city of Kennett, Mo., plans to apply to the R.F.C. for a loan of $150,000 for the construction of a municipal light and power plant and distribution system.

Black Canyon Irrigation District, Payette, Idaho, has authorized its president to apply to the R.F.C. for a loan of $1,000,000 for improvement of the district's irrigation system.

The Grand Teton Reservoir Co., Sugar City, Idaho, authorized an application for an R.F.C. loan of $1,500,000 to be used for construction of the Grand Teton reservoir and for canal building.

Salem, Oregon, has applied to the R.F.C. for a loan for the construction of a new dock and a terminal.

A possibility in connection with the application of the sanitary district of Chicago is that a definite allotment of water charges might be made for sewage disposal. It is known that the officials of the R.F.C. would welcome a plan which would bring that project within the terms of the act. As yet, however, no concrete plan has been submitted. Perfecting of the application is awaiting progress in that direction.

Wisconsin Waterworks Men Discuss Operating Problems

Sewer rental law in its relation to waterworks, economical replacement of pumping equipment, federal relief and unemployment construction, shutoff policy, water rates and construction, main sterilization, two-main systems, service pipe experiments, elevated tanks and paint were topics discussed Oct. 11 and 12 at the Appleton convention of the Wisconsin Section, American Water Works Association. The meeting had the largest attendance in its 11 years history, 137.

Charles P. Hoover, chemist, Columbus, O., discussing the relative merits of lime-soda ash and zeolite methods of softening concluded that green sand zeolite is usually preferred to soften water with some iron in it or with waters deficient in silica. Synthetic gel zeolite is preferred for low iron-bearing waters or water previously sand filtered.

Discussing a proposed sewer rental law Adolph Tanneberg, railroad commissioner, Madison, Wis., stated that of twenty-one cities financed under the Ohio sewer rental law ten employ a schedule of charges based on water consumption and eleven use a flat rate, special rates being provided in all cases for industries, hospitals, schools and public buildings. E. E. Parker, city engineer, Madison, pointed out certain difficulties. In a survey of water consumption by the Madison Metropolitan Sewage Commission a variation of as much as 1 to 100 was found for similar types of residences. One industry produces one-seventh of the sewage of the city in quantity and two-thirds of the treatment load by strength.

L. R. Howson, consulting engineer, in his paper on the relation between water works rules and construction policies in municipally-owned plants made a plea for uniformity of rates sufficient to make the works self-sustaining, comprehensive programing of improvements and a continuity of management and operation policy through a non-partisan water commission with long overlapping terms of office.

Replacement of pumping equipment with new higher efficiency units especially in small installations was stressed by Homer P. Binder. In discussion Mr. Nordberg described an entirely new type of pump designed abroad with a capacity of 10,500 gal. per minute operating at 200 r.p.m. driven by an 840-hp. engine, giving an efficiency of 94 per cent.

Experimental work on service pipes and fixtures at the University of Wisconsin, indicating large head losses between curb and faucet, was described by Prof. F. M. Dawson.

Experiments in sterilizing new water mains laid in sewage impregnated soil were described by Norton A. Thomas, chemist and bacteriologist, Milwaukee, while O. T. Birkeness, sanitary engineer, Milwaukee, recounted a number of outbreaks of waterborne diseases traced to unsterilized new mains. J. P. Schwada, city engineer, Milwaukee, described investigations by the engineering department of the relation between gastro-enteritis cases and water characteristics in connection with consideration of a filtration program.

Henry P. Bohman, superintendent, Milwaukee waterworks, was elected chairman and L. F. Warrick, state sanitary engineer, vice chairman. Leon A. Smith, superintendent, Madison Water Works, was re-elected secretary-treasurer.

Engineers Named to Advise Faculty of New York University

A committee of engineers to act as advisers to the faculty with respect to the curriculum of the College of Engineering has been appointed by the council of New York University. In appointing the committee the council is following a practice recently adopted at a number of other universities and colleges of calling on men in various walks of life outside of the college faculty to review the curriculum in fields in which they are familiar with current practice, to advise as to the adequacy of the course and to make recommendations for possible changes. The committees usually work with faculty committees and with alumni committees familiar with the traditions of the school.

The committee appointed for New York University is made up of Leon P. Alford, industrial engineer; William L. Batt, mechanical engineer; Robert W. Boyd, engineer, Turner Construction Co., New York; John V. N. Dorr, metallurgical and chemical engineer, president of the Dorr Co.; Frank B. Jewett, electrical engineer; Grover Loening, aeronautical engineer; and Robert Ridgway, consulting engineer, Board of Transportation, New York City.

SOCIETY CALENDAR

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Washington, D. C., Nov. 14-18.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, Detroit, Mich., Jan. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention and road show, Detroit, Mich., Jan. 16-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS annual meeting, New York, N. Y., Jan. 18-21.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-20.

AMERICAN TOLL BRIDGE ASSOCIATION, annual meeting, Camden, N. J., Jan. 16-17.

ASPHALT INSTITUTE, Asphalt Paving Conference, New Orleans, La., Dec. 5-9.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, Detroit, Mich., Jan. 16-18.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 1-2.

HIGHWAY AND BUILDING CONGRESS participated in by twenty national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Detroit, Mich., Jan. 16-18.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Ottawa, Ont., Feb. 7-8.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS, annual meeting, Hot Springs, Ark., Nov. 15-18.

NATIONAL CONFERENCE ON CITY PLANNING, annual meeting, Pittsburgh, Pa., Nov. 14-16.

NATIONAL CRUSHED STONE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

NATIONAL READY MIXED CONCRETE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 18.

NATIONAL SAND & GRAVEL ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

PORTLAND CEMENT ASSOCIATION, Detroit, Mich., Jan. 16-18.

Personal Notes

ALEX. O. TAYLOR, of Concord, N. H., who until recently was contracting engineer with the Luten Bridge Co. in the New England territory, has returned to private practice, opening an office in Montgomery, Ala. Previously Mr. Taylor was county engineer of Palm Beach County, Fla., and also a member of Butler, Barnett & Taylor, consulting engineers, West Palm Beach, Fla.

R. P. DAVIS has been appointed dean of the College of Engineering at West Virginia University to succeed C. R. Jones, who becomes dean emeritus. Professor Davis is a graduate of Massachusetts Institute of Technology and Cornell University. After graduation he was employed by the American Bridge Co., later going to Cornell University as instructor. He went to West Virginia University in 1911 and has served as professor of structural and hydraulic engineering and as assistant dean. From 1914 to 1919 he was bridge engineer of the West Virginia State Road Commission and since 1919 he has acted as consulting bridge engineer.

Obituary

R. F. SCHUCHARDT, chief electrical engineer, Commonwealth Edison Co., Chicago, died at Boston on Oct. 26, aged 56 years. Mr. Schuchardt was a past-president of the American Institute of Electrical Engineers.

HENRY R. LORDLY, consulting engineer, Montreal, died there recently, aged 62. Mr. Lordly was a graduate of Cornell University and was engineer of design and construction on the Lachine Canal at Montreal.

GEORGE H. HARROWER, retired construction engineer, Buffalo, N. Y., died there on Oct. 26, aged 78 years. Mr. Harrower was a graduate of the University of Michigan. For nearly half a century he has lived in Buffalo. He was formerly a member of the H. C. and G. H. Harrower Construction Co.

NILS L. MALROS, formerly engineer of the architectural firm of Ernest Flagg, New York, died at his home in Jamestown, N. Y., Oct. 21, aged 71. Born in Malmö, Sweden, Mr. Malros came to this country after studying engineering and architecture there and in Copenhagen and was for many years engaged in architectural offices, chiefly as a specification writer. In that capacity he wrote many of the specifications for the Singer Building, one of New York's earliest skyscrapers.

CHARLES E. ASHBURNER, the first man to hold the position of city manager in this country, died at Norfolk, Va., on Oct. 26. Born in Bombay, India, in 1870, Mr. Ashburner came to this country as a young engineering graduate and after engaging for some years in municipal engineering work was appointed city manager of Staunton, Va., in 1904. In taking this position Mr. Ashburner became the first city manager to be named to that position. Subsequently he was city manager of Springfield, Ohio, 1914-1918; Norfolk, Va., 1918-1923; Stockton, Calif., 1923-1929.

Engineering Section Meeting of Public Health Association

(Continued from p. 538)

"Noise and Its Relation to Health," presented an able psychological analysis of the attitude of the individual and the public to noise. He said that direct health relations are difficult to demonstrate but unquestionably exist.

It was emphasized by T. L. Costigan, superintendent of street cleaning, Washington, D. C., that the extensive all-night parking of automobiles was a serious interference with street cleaning.

A paper on "Purification of Beet Sugar Wastes," by Max Levine, of Iowa State College, described experiments covering three annual operating periods at a beet sugar plant. Sedimentation of wastes for various periods and in various combinations accomplished comparatively little reduction in solids and biochemical oxygen demand. Sedimentation followed by double filtration, first through a washable trickling filter 3 ft. deep and then through a normal trickling filter 6 ft. deep, resulted in more than 95 per cent reduction in solids and b.o.d.

The Conference of State Sanitary Engineers elected as chairman of the conference for the ensuing year L. F. Warrick, state sanitary engineer, Wisconsin. W. H. Weiters, state sanitary engineer of Iowa, was elected vice-chairman. Ralph E. Tarbett, of the United States Public Health Service, continues as secretary.

The Public Health Engineering Section elected as officers for the ensuing year Theodore La Freniere of Montreal, Que., chairman; C. A. Holmquist, Albany, N. Y., vice-chairman; and Arthur P. Miller, Washington, D. C., secretary.

Bids Called for Long Tunnel

Contractors' bids on the building of the San Jacinto tunnel for the proposed Colorado River aqueduct will be opened Nov. 19, under terms of a resolution adopted Oct. 21 by directors of the Metropolitan Water District of Southern California, authorizing the advertising for bids. The tunnel will be one of the largest single items in the entire construction project, being thirteen miles long and requiring an estimated six years to build. It is expected to cost approximately $10,000,000.

The board of directors also has approved specifications for construction of the electrical power supply lines that will be required during the construction of the proposed aqueduct and has ordered the advertising of bids for the work. The specifications call for the construction of forty-five miles of 66,000 volt, twelve miles of 33,000 volt and considerably more smaller capacity line.

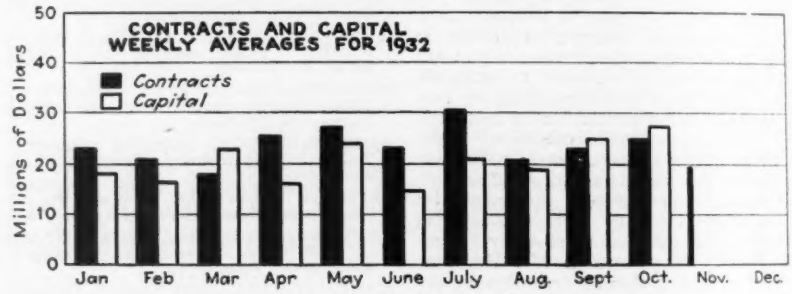
Electrical energy required in the aqueduct construction will be supplied jointly by the Southern California Edison Co., the Los Angeles Gas and Electric Corp. and the Southern Sierras Power Co. Directors of the district voted July 15, this year, to accept the joint power supply bid of the three Southern California companies.

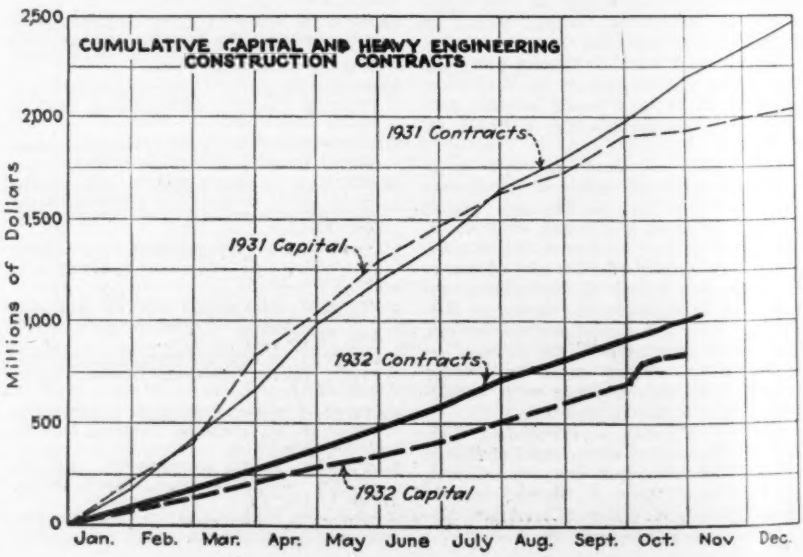
Engineering Contracts and Capital

HEAVY ENGINEERING construction contracts reported for the past week total $19,600,000, a considerable drop from the October weekly average of $25,200,000. Private contracts were the lowest since the first week in September, amounting to 2 millions. Federal awards totaled $7,430,000, falling but little from the amounts reported for this class the previous two weeks. Highway lettings passed the previous week by $600,000, amounting to $8,468,000. Levee contracts equalled those of the previous week, $5,292,000. Public buildings were unusually low, contracts totaling $1,898,000. Texas accounted for half of the week's highway work, letting contracts aggregating $4,450,000. Levee awards in Arkansas and Mississippi amounted to $3,119,000.

Several large projects were placed on the proposed list. Bids will be opened November 10 for the Archives building at Washington, estimated at $8,750,000. Two large residential developments are scheduled for New Jersey, one at Teaneck to cost $1,000,000, and another at Belleville, estimated at $750,000. A paper mill at Bogalusa, La., is contemplated, to cost $1,250,000. A proposed federal building at Los Angeles will cost $5,000,000 and a post-office for San Antonio at $1,250,000.

New capital issues reported for the week total $8,000,000, including $225,000 Reconstruction Finance Corp. self-liquidating loans. Private loans consisted of $1,100,000 railroad work loans. The R.F.C. loans announced on Nov. 1 are not included in this week's figures.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Oct., 1931	Weekly Average Oct., 1932	Week Nov. 3, 1932
Federal government	$5,556	$6,263	$7,430
State and municipal	14,952	13,700	10,136
Total public	$20,508	$19,963	$17,566
Total private	14,182	5,240	2,034
Week's total	$34,690	$25,203	$19,600
Cumulative, Jan. 1 to date:			
1931 construction			$2,224,976
1932			1,035,106

Decrease 54 per cent.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Oct., 1931	Weekly Average Oct., 1932	Week Oct. 29, 1932
R.F.C. loans	.....	$16,800	$225
New capital issues	$6,200	11,000	8,600
Total	$6,200	$27,800	$8,825
Cumulative, Jan. 1 to date:			
1931 new capital			$1,924,000
1932 R.F.C. loans		$124,700	
1932 new capital		716,000	
1932 total			$840,700

Decrease, 56 per cent.

ENR Cost and Volume Index

Cost		Volume	
November, 1932	**158.20**	**October, 1932**	**137**
October, 1932	159.16	Sept., 1932	124
November, 1931	169.28	October, 1931	229
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.85	1930 (Average)	260
1913 Average	100.00		

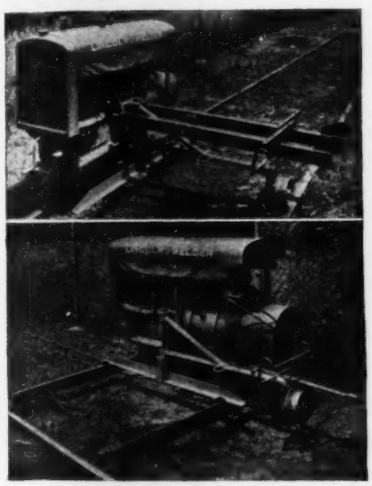
Construction Equipment and Materials

Rail Welder Can be Removed From Track Quickly

Quick removal from the track is the outstanding feature of the new track welder for building up worn railends and repairing frogs, crossings and switches, announced by the Lincoln Electric Co., Cleveland, Ohio. The manufacturer states that one man in one minute can quickly remove the unit from the track or place it in position for use.

Removal from the track is accomplished by removing the take-off rails from the carriage and placing them in position opposite the take-off rolls, where they fit over the flange of the track with cross supports resting on the ties. After the take-off rails are in position, the handle is lifted and the unit pushed to the end of the rails. The third wheel is then swung out of the way, leaving a clearance of not less than 36 in. to the nearest rail.

The welder is of standard Lincoln construction with a rating of 200 amperes.



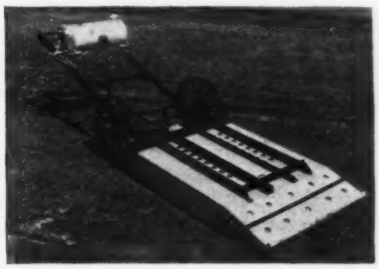
Lincoln track welder carries two removal rails for rapid handling

Welding capacity is from 50 to 250 amperes. Either bare or coated electrodes may be used. The machine is equipped with double generators so that welding and grinding may progress at the same time. The generators are driven by a four-cylinder gasoline engine developing 26 hp. at 1,800 r.p.m. The grinder generator is rated at 115 volts, 5 kilowatts.

Surface Heater for Highways

A surface heater for highway maintenance, designed to prevent warping and burning of the hood, has been introduced by Littleford Bros., Cincinnati, Ohio. To protect the hood from the great heat of the burners it is strengthened with angle-iron stiffeners on top and cast-iron liner plates inside. In addition, ventilating holes in the top of the hood allow excess heat to escape, thereby preventing heat pockets.

The heating hood is made in two standard sizes, 5x3 ft. and 6x4 ft. Each size is equipped with two torch-type oil burners that generate heat up to 1,800 deg. F.



Surface heater strengthened against warping

By removing the fuel tank from the handles and removing the burner, the heater can be towed by a truck by folding the heater hood back on the handle.

New Equipment in Brief

Level Recorder. A new recorder for the water level of reservoirs, wells and streams is announced by the Rational Manufacturing Co., Redondo Beach, Calif. The instrument has a horizontal record cylinder 1 ft. in circumference and the record sheet is graduated in tenths and one-hundredths of a foot. Reducing gears are furnished and allow the cylinder to record 1, 2, 5, 20 or 100 ft. per revolution. A safety feature of the instrument is that the record cylinder cannot be put in without the instrument being in gear. The float pulley groove is flat on the bottom to accommodate one and a half turns of wire. The float is of heavy copper.

Stainless Steel. Ingersoll Steel & Disc Co., Chicago, Ill., announces a two-ply stainless steel. The new metal, known as Ingoclad stainless steel, is produced from a composite ingot. The manufacturer states that a perfect bond exists between the stainless steel and the carbon steel back. Among the uses for which the metal is suitable, the manufacturer includes power shovels, road machinery, pump parts, dump cars and other uses where corrosion resistance and strength are desired.

Diffuser Plate. Diffuser plates and tubes for the aeration of sewage made of a material that is prepared from bauxite ore has been introduced by the Carborundum Co., Niagara Falls, N. Y. The material, known as Aloxite, is made by melting the bauxite ore in company with coke and iron turnings in definite proportions to produce a highly refined crystalline alumina. Selected grains of the alumina are then bonded together with a special clay bond and molded into shape under pressure and then vitrified at high temperature. The new material has a porosity varying from 34 to 38 per cent and standard briquettes develop a tensile strength up to 3,000 lb. per sq.in. Standard plates are 12x12x1 in. and standard tubes are 24 in. long, 3 in. internal diameter with ⅜ in. wall.

New Heavy-Duty Tractor

An addition to its crawler tractor line has been announced by the International Harvester Co., Chicago, Ill. It is the new model T-40 six-cylinder TracTracTor. The new tractor develops a maximum drawbar horsepower of 40 and a maximum engine horsepower of 52. The manufacturer states that it is especially well suited for heavy construction work such as road, dam, levee, irrigation and oil-field work.

A feature of the new tractor is the accessibility of all working parts. Steering clutches, transmission, and brakes may be readily inspected, adjusted or removed through top and rear cover plates. Special dust seals guard the shaft and bearing.

Crawler tractor by International Harvester Co.

The six-cylinder engine is of valve-in-head design and has removable cylinders of 3⅜-in. bore and 4½-in. stroke. The tractor operates at five forward speeds, respectively, 1⅞, 2¼, 2¾, 3¼ and 4 miles an hour, and at 2¼ miles in reverse.

New Publications

Rock Crusher. Bulletin No. 111 published by the Traylor Engineering & Manufacturing Co., Allentown, Pa., describes that company's new type BH gyratory crusher. The machine embodies the patented Traylor bell head and curved concaves, designed to give large capacity to sizes smaller than the minimum setting of standard gyratory machines. The manufacturer claims that the new crusher has a low power consumption and maintenance cost.

Rock Drilling. Sullivan Machinery Co., 400 North Michigan Ave., Chicago, has just issued a new loose-leaf catalog of its equipment, parts and supplies used in connection with hammer drills in mines, quarries and on construction work. These sections include complete description of columns, tripods and quarry bars, and their parts in detail for ordering; also rock drill steel; tools for clay spaders and concrete breakers; pneumatic and electric concrete surfacers; throttle valves and manifolds. A separate section is devoted to Sullivan "Blue Dragon" and other brands of air and water drill hose. Paint spraying equipment and blow guns, roller bearing sheaves, lighting cable and portable electrical instruments are also included in the catalog.

Road Machinery. Road machinery used in conjunction with Caterpillar tractors are analyzed in a comparative fashion in a tabular file sheet recently issued by the Caterpillar Tractor Co., Peoria, Ill. The sheet tabulates the dimensions, capacities and significant characteristics of seven models of tractors, six blade graders, four maintenance machines, two elevating graders and one planer.

Valves. The bar-stock valves manufactured by the Reading-Pratt & Cady Co., Inc., Bridgeport, Conn., are described in a new 8-page catalog issued by that company. These valves are precision turned from high grade bar stock metal and are recommended by the manufacturer wherever a high strength, close control and low-cost valve is desirable. The valves are made in globe, angle and cross patterns of bronze, carbon steel and stainless steel.

Business Side of Construction

October Heavy Contracts Show Unseasonal Rise

HEAVY ENGINEERING construction contracts reported during October (four weeks) total $100,812,000, or 25.2 millions per week, as compared with 22.9 millions per week reported for September. This rise, while slight, is unseasonal, as in past years contract awards have dropped off from September through the end of the year. Public awards per week were almost identical in October and September, while private contracts increased from 2.7 millions in September to 5.2 millions in October. Highway lettings for the month did not reach the high of the year established in September, 12.5 millions per week, but were stronger than any other month, amounting to 9.7 millions per week. Federal contracts for October gained 50 per cent over the previous month, averaging $6,200,000 weekly. Much of this increase was accounted for by Mississippi and Missouri river levees and revetments, as public buildings, including federal, amounted to 4.1 millions per week for both September and October.

In the geographical distribution of contracts, figured on weekly averages, the South, Midwest, West of the Mississippi and Far West sections all showed increases for October, while New England awards remained stationary and the Middle Atlantic section registered a decrease. Private non-residential building showed a slight increase over September figures, making up a similar loss for this class encountered between August and September.

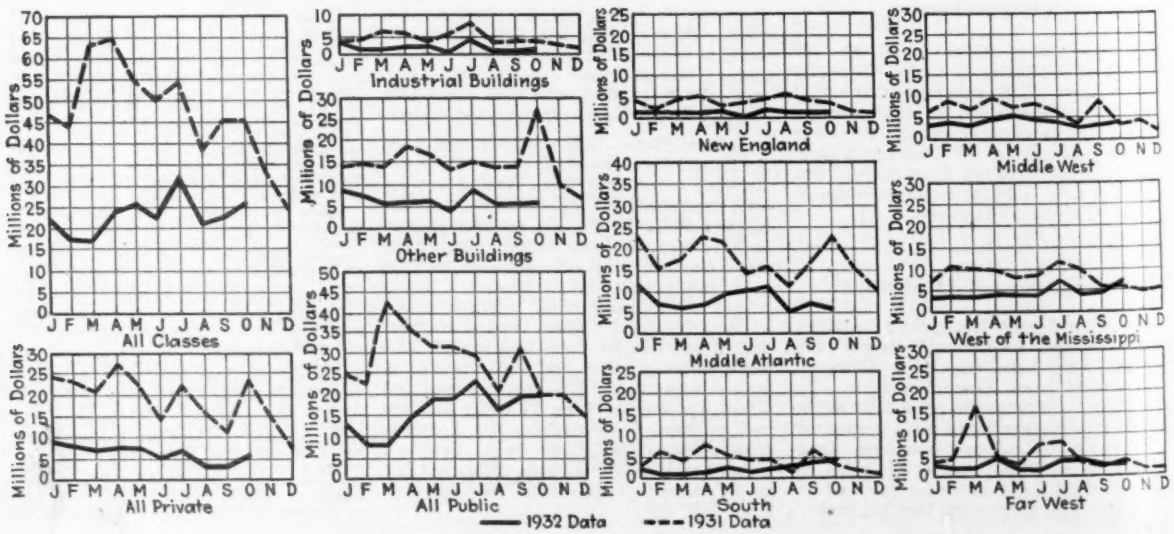
Indications are that the present volume of construction will be maintained throughout the fall quarter. Bids have been taken on the Golden Gate Bridge, to cost about $24,000,000. November will see bids opened on the San Jacinto tunnel, 13 miles long, the first unit in the Metropolitan Water District's aqueduct between Parker, Ariz., and southern California. Other projects financed by Reconstruction Finance Corporation self-liquidating loans are expected to be under way within the next two months.

Geographical distribution of heavy engineering construction contracts reported in October, 1932 (four weeks) in thousands of dollars. Federal contracts are included in regular classifications, but are also shown separately as a matter of record. Below are shown weekly average contract awards, in millions of dollars, for various classes of work and for different sections of the country.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN OCTOBER, 1932
Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States Oct., 1932	United States Ten Months 1931	United States Ten Months 1932	Canada Oct., 1932
Waterworks	233	267	57	491	107	454	1,609	50,683	24,136	57
Sewers	72	363	.....	35	325	112	907	60,438	20,787	.....
Bridges, public	1,099	367	548	1,057	1,749	922	5,742	112,354	46,470	25
Earthwork and waterways	331	747	5,145	388	7,681	685	14,977	19,436	80,676	145
Streets and roads	1,627	6,871	8,265	8,489	8,622	4,920	38,794	483,093	320,065	308
Unclassified, public	157	706	21	68	8	575	1,535	72,595	35,750	542
Buildings, public	172	6,848	2,990	2,719	1,355	2,204	16,288	218,935	203,111	62
Total public	3,691	16,169	17,026	13,247	19,847	9,872	79,852	1,259,652	731,297	1,139
Federal government (included in above classifications)	428	3,124	6,332	2,444	9,103	3,621	25,052	*242,116	216,176	.....
Buildings, industrial	395	2,664	328	779	269	2,157	6,592	148,918	78,928	.....
Buildings, commercial	1,085	3,038	24	1,645	751	470	7,013	513,791	146,647	.....
Bridges, private	.....	68	73	.....	73	.....	214	10,359	3,908	.....
Earthwork, private	.....	.....	.....	.....	.....	.....	.....	.....	850	.....
Unclassified, private	114	1,380	100	153	4,394	1,000	7,141	257,567	54,176	.....
Total private	1,594	7,150	525	2,577	5,487	3,627	20,960	930,635	284,209	.....
October, 1932 (4 weeks)	**5,285**	**23,319**	**17,551**	**15,824**	**25,334**	**13,499**	**100,812**	.....	.....	**1,139**
September, 1932 (5 weeks)	6,315	36,253	20,847	17,781	22,253	11,038	114,487	.....	.....	3,500
October, 1931 (5 weeks)	16,663	119,730	18,962	19,691	28,271	21,856	225,173	.....	.....	9,229
Ten months, 1932	65,439	345,918	99,623	177,075	200,162	127,289	.....	.....	1,015,506	43,556
Ten months, 1931	164,388	848,666	216,888	334,198	353,257	272,890	.....	2,190,287	.....	100,531

* Not included in other classifications.



Cost index drops slightly

After maintaining a steady rise since passing a 16-year low in June, the *ENR* Cost Index dropped slightly for November, now standing at 158.20 as compared with 159.16 for October. A turn towards lower common wage rates in a few centers was responsible for the decline. Materials prices entering into the index remained stationary. The *ENR* Volume Index rose thirteen points for October, reaching 137, a figure surpassed only by May and July of this year.

Steel rails drop

The most sensational turn in the steel industry during the month was the $3 drop in the price of standard steel rails, which have remained at $43 per ton since 1922. Since the price decrease was announced several railroads have placed rail orders and others have signified intention of following. The decline in rail prices did not affect other steel products, plates and structurals remaining the same.

Production of steel during the month averaged 20 per cent of capacity, an increase over August and September outputs. In fact, production has increased 40 per cent over the low point touched in August. Figures compiled by the American Iron & Steel Institute show production for the first nine months of the year averaged 20.09 per cent of capacity, with 26.96 per cent in February being high for the year and 14.26 per cent in August being low. The lowest point in production reached last year was during December, with output at 23.56 per cent of capacity.

Cement production increases

Figures compiled by the Bureau of Mines show that the production of portland cement increased from 34.2 per cent of capacity in August to 36.9 per cent in September. The cement industry produced 8,189,000 bbl., and shipped 9,722,000 bbl. during September, and had in stock at the end of the month 17,865,000 bbl. Production during the month showed a decrease of 32.2 per cent and shipments a decrease of 28.9 per cent as compared with September, 1931. Stocks at the mills are 21.4 per cent lower than a year ago.

Building permits

Building permits reported by S. W. Strauss & Co. for September were $36,036,718 for 576 cities, as compared with $33,684,000 for the same cities in August, an increase of 1.04 per cent. Detroit took first place in the amount of permits issued with $4,163,872, displacing New York as the leader for the first time in a decade. New York was second, reporting permits totaling $3,927,212. Chicago was 24th on the list, with only $237,950.

Labor notes

Very little change was noted in labor rates during the month. H. C. Turner, of Turner Construction Co., New York, advocated a reduction in building trades wages as the only means to stimulate building, talking before the workmen gathered to receive craftsmanship awards on the New York Port Authority Inland Terminal building.

New Orleans—The reduction of relief work wages from $2.50 to $1.50 per day caused a "strike" of the unemployed workers, who later returned to their jobs, contending that the new scale wasn't much worse than the former one, held entirely inadequate to provide living for a family.

Montreal—After considerable controversy among the board of councilmen, advocates of day-labor municipal construction gave way to proponents of the contract system. The city is planning a $5,000,000 sewer program for relief work. Between 7,000 and 8,000 workers will be taken care of at the rate of 40c. per hour, with three 8-hour shifts being in effect.

Pennsylvania—The state highway department announced that 41,430 workers are on the highway payroll at present, 36,157 working directly for the department, the remainder being employed by contractors.

Florida—Florida road workers will receive a minimum of 25c. and 40c. for unskilled and skilled labor respectively, an increase of 5c. per hour over rates previously announced.

Newark, N. J.—Work has been resumed on the foundations for the new postoffice after a two-week delay due to jurisdictional disputes on the part of several labor unions. Engineers and ironworkers will divide the work of sinking the steel caissons.

Washington, D. C.—Union painters returned to work after striking in demand for a 6-hour day. The question will be arbitrated, contractors holding out for the present 8-hour schedule.

Iowa—Emergency federal aid highway projects in Iowa are furnishing employment to 3,406 workers.

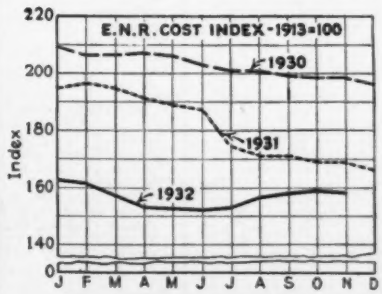
San Francisco—Maintaining present wage scales for 1933 was advocated by contractors appearing before the Impartial Wage Board.

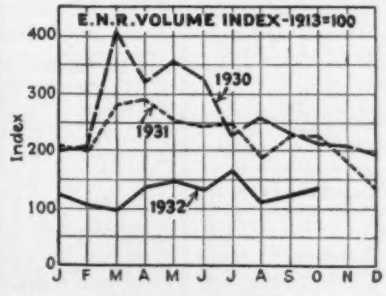
CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structural Iron Workers	Masons' Laborers	Common Laborers
Atlanta	$0.75@1.12½	$0.40@.90	$0.60@1.25	.....	$0.60@1.25	$0.25	$0.20@.25
Baltimore	.62½@1.00	.65@.90	1.00@1.37½	$0.65	1.00@1.25	.40	.30
Birmingham	.75@.87½	.60	.75	.....	.75	.25	.20@.30
Boston	.90@1.30	.70@1.17½	1.00@1.17½	.70@1.07½	1.00@1.20	.45@.70	.40@.70
Cincinnati	.90@1.27½	.50@1.02½	1.07½	1.07½	1.06½@1.20	.70	.40@.45
Chicago	1.37½	1.31¼	1.31¼	1.31¼	1.35	.82½	.50@.82
Cleveland	.90@1.37½	.75@1.12½	.90@1.12½	1.00	.90@1.06¼	.56¼	.30@.72
Dallas	.62½	.50	.50	.50	.50	.25	.25@.35
Denver	1.00@1.12½	.75@.87½	.75@.87½	.....	.75@.87½	.50	.31½@.50
Detroit	.75@1.50	.55@.80	1.25	1.25	1.25	.70	.30@.50
Kansas City	1.30	1.12½	1.12½	1.06	1.12½	.82½	.35@.40
Los Angeles	.62½	.50	.625	.625	.625	.50	.35@.50
Minneapolis	.90@1.00	.75	.75	.....	.90	.50	.40@.50
New Orleans	.60@.80	.40@.50	.80@1.12½	.90	.80@1.12½	.50	.15@.20
New York	1.50@1.65	1.25@1.40	1.50@1.65	1.50	1.65	.81¼@1.00	.50@.75
Philadelphia	1.00@1.25	.60@.90	1.00	.75	1.00	.30@.40	.20@.30
Pittsburgh	.60@1.50	.60@1.25	.60@1.37½	1.00@1.18¾	.60@1.37½	.50	.40@.70
St. Louis	1.50	1.25	1.35@1.47	1.25	1.47	1.00	.35@.78½
San Francisco	1.10	.90	.90	1.00	1.00	.62½	.50@.62½
Seattle	.75@1.20	.50@.90	1.00	.90	1.10	.66	.40@.50
Montreal	.75	.60	.55	.....	.70	.45	.25@.30

Construction Cost and Volume Index Numbers

A slight drop in the Cost Index for November, which stands at 158.20 as compared with 159.16 for October, checked the steady rise of the Index prevalent since last June. Materials prices entering into the Index remained stationary, but reports of slightly lower common wage rates in a few cities depressed the Index figure below that of last month. The Volume Index for October showed a considerable gain, jumping to 137 from the September figure of 124.





E.N.-R. Cost		E.N.-R. Volume	
November, 1932	**158.20**	**Oct., 1932**	**137**
October, 1932	159.16	Sept., 1932	124
November, 1931	169.28	October, 1931	229
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.85	1930 (Average)	260
1913 average	100.00		
1931		1931	
January	194.48	January	208
February	196.61	February	198
March	194.51	March	278
April	191.63	April	289
May	189.33	May	251
June	187.23	June	243
July	174.37	July	248
August	171.38	August	187
September	171.40	September	225
October	169.78	October	229
November	169.28	November	180
December	166.23	December	133
1932		1932	
January	162.48	January	121
February	161.82	February	105
March	157.24	March	97
April	153.12	April	135
May	152.78	May	149
June	152.20	June	131
July	153.36	July	166
August	156.80	August	111
September	157.96	September	124
October	159.16	October	137
November	158.20		

Current Prices of Construction Materials

Building Materials

PORTLAND CEMENT — Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered		F.o.b.	Delivered
Atlanta	$2.33	$2.85	Kansas City	$1.60	$1.70
Baltimore	....	2.03	Los Angeles	2.10	2.10
Birmingham	2.02	2.12	Minneapolis	2.10	2.25
Boston	1.58	1.68	Montreal	1.70	....
Chicago	1.60	1.95	New Orleans	1.90	2.20
Cincinnati	1.37	1.52	New York	1.59	1.70
Cleveland	1.72	1.95	Philadelphia	1.84	1.94
Dallas	2.80	3.00	Pittsburgh	1.68	1.78
Denver	....	2.40	St. Louis	1.64	1.95
Detroit	1.47	1.80	San Francisco	2.05	....
			Seattle	2.55	2.70

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich.	$1.20	Mason City, Ia.	$1.35
Buffington, Ind.	1.25	Norfolk, Va.	1.61
Dallas, Tex.	1.75	Northampton, Pa.	1.40
Hannibal, Mo.	1.25	North Birmingham, Ala.	1.60
Hudson, N. Y.	1.50	Richard City, Tenn.	1.70
Independence, Kan.	1.35	Steelton, Minn.	1.45
Ironton, Ohio	1.06	Universal, Pa.	1.21
Iola, Kan.	1.35	Waco, Tex.	1.75
La Salle, Ill.	1.25	Wyandotte, Mich.	1.20
Limedale, Ind.	1.25		

SAND AND GRAVEL — Per ton, carload lots, gravel, size ¼-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.55	....	2.08
Birmingham, per cu.yd.	....	3.00	....	2.40
Boston	1.40	1.65	.90	1.15
Chicago, per cu.yd.	....	2.25	....	2.25
Cincinnati	1.20	1.65	.95	1.40
Cleveland	....	2.00	1.40	2.00
Dallas, per cu.yd.	1.40	2.40	1.65	2.40
Denver, per cu.yd.	1.75	1.85	1.15	1.20
Detroit	.50	1.45	.72	1.50
Kansas City	.75	....	.60	....
Los Angeles	1.10	1.10	.75	.85
Minneapolis	....	1.60	....	.65
Montreal	1.50	....	.80	....
New Orleans	1.50	2.50*	1.20	2.00*
New York, per cu.yd.	1.60	3.25	1.00	2.00
Philadelphia	....	1.66	....	1.38
Pittsburgh	....	1.20	....	1.40
St. Louis	.25	1.15	.75	1.15
San Francisco	1.75	....	1.75	....
Seattle, per cu.yd.	1.75	....	1.75	....

*Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	.80	1.05
Boston	1.40	1.65
Chicago, per cu.yd, 2,500 lb.	....	2.25
Cincinnati	1.65	1.85
Cleveland	....	2.00
Dallas, per cu.yd., 2,500 lb.	1.65	3.00
Denver, granite, per cu.yd., 2,700 lb.	....	2.50
Detroit	1.09	1.95
Kansas City	1.25	....
Los Angeles	1.10	1.10
Minneapolis	....	1.60
Montreal	1.35	....
New York, per cu.yd., 2,800@3,000 lb.	1.60	3.25
Philadelphia	....	2.00
Pittsburgh	....	2.25
St. Louis	1.35	1.65
San Francisco, trap rock	1.65	....
Seattle, per cu.yd., 3,000 lb.	1.10	....

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Slag Sand
Birmingham	$0.90	$1.15	$2.05	$0.55
Buffalo	1.35	1.35	2.00	1.25
Cleveland	1.70	1.70	....	1.35
Toledo	1.20	1.20	1.20	1.10
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown	1.10	1.20	2.00	.75

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Birmingham (5x8x12)	$0.084	Kansas City	$0.18
Boston	.15	Los Angeles	.15
Brooklyn and Queens	.12	Minneapolis	.09
Chicago	.175	Montreal	.14
Cleveland	.165	New Orleans	.17
Denver	.15	Philadelphia	.15
Detroit	.08	Pittsburgh	.14
		St. Louis	.14

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered 50 cu.yd. or more:

Atlanta	$7.75	Los Angeles	$5.25
Birmingham	4.90	Minneapolis	6.00
Boston	6.50	New Orleans	6.20
Cincinnati	6.10	New York (Manhattan)	8.50
Dallas	6.25	Philadelphia	5.98
Detroit 1:2½:5	4.75	Pittsburgh	5.75
Kansas City	7.50	St. Louis	6.15
		Seattle	5.35

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.10	.14	.20	.22	.30
Birmingham	.089	.122	.167	.219	.25
Boston (at plant)	.075	.11	.14	.20	.30
Chicago	.0484	.063	.09	.1179	.13
Cincinnati	.06815	....	....	.165	....
Cleveland	.048	.066	.09	.117	.13
Dallas	.067	....	....	.173	....
Denver	.085	.135	.175	.19	.25
Detroit	.0505	.065	.0947	.1175	.1305
Kansas City	.0735	.092	.15	.1727	.20725
Los Angeles	.09425	.134	.188	.2325	.3115
Minneapolis	.0635	.09395	.1232	.13425	.2103
New Orleans	.085	.115	.16	.225	.255
New York	.075	.1164	.145	....	....
Perth Amboy	....	....	....	.2388*	.2956*
Philadelphia	.065	.093	.14	.175	.195
Pittsburgh	.0435	.065	.088	.1165	.126
St. Louis	.062	.088	.118	.16	.20
San Francisco	.0765	.105	.1765	....	....
Seattle	.085	.115	.18	....	....

*At plant. (Load-bearing tile).

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Paving
	F.o.b.	Delivered	F.o.b. 3x8½x4-in.
Atlanta	$8.50	$14.00	$32.00
Baltimore	....	11.50	43.00†
Birmingham	10.00	12.50	25.60
Boston	12.00	16.00	43.00
Chicago	....	9.00	32.00
Cincinnati	13.50	16.00	36.50
Cleveland	12.00	14.00	33.00
Dallas	11.00	12.00	25.00†
Denver	13.00	....	40.00
Detroit	11.50	12.50	25.00
Kansas City	12.00	13.00	35.00
Los Angeles	8.00	8.50	....
Minneapolis	....	7.50	....
Montreal	21.50	....	....
New Orleans	10.50	14.50	40.00
New York	9.50	11.50	45.00
Philadelphia	....	13.00	40.00
Pittsburgh	11.00	13.00	35.00
St. Louis	....	12.00	32.00†
San Francisco	....	14.00	45.00*
Seattle	12.00	14.00	....

*2½x8½x4 in. †3½x8½x4 in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net:

	Hydrated				Common Lump	
	Finishing		Common			
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	....	$2.50
Baltimore	....	20.00	....	13.00	....	....
Birmingham	21.00	....	12.00	....	1.65	....
Boston	17.00	19.00	14.00	16.00	$2.35*	3.25*
Chicago	....	20.00	....	14.00	....	2.75
Cincinnati	10.00	11.00	8.65	9.65	....	....
Cleveland	10.50	14.00	8.50	12.00	....	2.50
Dallas	....	20.00	....	....	....	2.50
Denver	....	30.00	....	22.00	....	2.85*
Detroit	9.25	14.00	7.25	12.00	....	....
Kansas City	....	22.00	....	....	....	2.75
Los Angeles	24.00	26.00	17.00	18.00	....	2.00
Minneapolis	....	21.00	....	19.00	....	1.70
Montreal	....	18.00	12.00	13.00	....	....
New Orleans	14.75	22.50	11.50	14.00	1.66	1.95
New York	10.70	14.50	8.60	12.50	2.25*	3.15*
Philadelphia	11.50	15.39	9.90	13.49	....	1.18
Pittsburgh	11.50	13.00	10.75	12.25	1.85	2.35
St. Louis	....	.45‡	....	.40‡	....	2.15
San Francisco	19.00	19.00	19.00	19.00	....	1.85
Seattle	....	32.00	....	24.00	....	2.80

*Per 280-lb. bbl. (net.) ‡Per sack.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:
New York:* Rustic buff, $1.48; Standard gray, $1.48; Standard buff, $1.58; Selected gray, $1.58; Selected buff, $1.68; Variegated, $1.48.
Boston: Rustic buff, $1.43; Standard, $1.56; Selected buff, $1.70.
Pittsburgh: Rustic buff, $1.56; Standard, $1.28 at quarry; Selected buff, $1.86.
Philadelphia: Sel. buff, $1.65; Sel. gray, $1.55; Standard, $1.55; Standard gray, $1.45; Rustic buff, $1.35.
Atlanta: Standard, $1.26.
*F.o.b. Bedford, freight allowed to N. Y.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square:

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Birmingham	76.25 per M.
Boston	90.00 per M.
Chicago, 5 in.	3.80 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	95.00 per M.
Dallas	25.00 per M.
Detroit, 5 in.	2.80 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½ in.	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in.	135.00 per M.
Philadelphia, 4x10x5	115.00 per M.
Pittsburgh	115.00 per M.
St. Louis, 5 in.	2.90 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING — Prices f.o.b., in carload lots:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.10
Chicago	3½	12	1.90
Kansas City	3½	16	2.65
Minneapolis	3½	16	2.25
Montreal	3½	16	2.63
New York	3½	14	1.90
Philadelphia	3½	16	2.02
St. Louis	3½	16	2.10

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	New York	$0.62
Birmingham	.50	Philadelphia (6x20 dressed)	1.40
Boston	.70	Pittsburgh	.80
Dallas	.60	St. Louis	.65@.70
Detroit	.45		

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$20.60	$16.40
Baltimore (f.o.b. refinery)	17.00	13.00
Bayonne (f.o.b. refinery)	17.00	13.00
Birmingham	.....	11.00
Boston	18.00	14.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	.....	8.00
Cleveland	18.25	14.50
Dallas	.....	27.00
Denver	27.50	.....
Detroit	16.80	12.43
Kansas City (f.o.b. refinery)	16.00	.....
Los Angeles (f.o.b. refinery)	18.00	12.00
Maurer, N. J. (Bermudes)	.....	26.00
Maurer, N. J. (Trinidad)	.....	22.00
Minneapolis (f.o.b. Twin Cities)	21.30	16.30
Montreal (f.o.b. factory)	17.00	13.00
New Orleans (f.o.b. refinery)	16.00	12.00
New York	19.00	15.00
Philadelphia	17.00	11.00
Pittsburgh	25.00	16.00
St. Louis (f.o.b. refinery)	14.00	10.00
San Francisco (f.o.b. refinery)	16.00	10.00
Seattle (f.o.b. refinery)	23.00	17.00

LIQUID ASPHALT — Residual, hot application, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Atlanta	$0.0539
Bayonne and Baltimore refineries	.05
Birmingham	.06
Boston	.055
Cincinnati	.075
Dallas	.05
Kansas City	.05
Los Angeles	.045
Montreal at (refinery)	.09
New York	.06
Philadelphia	.08
Pittsburgh	.05
St. Louis (at refinery)	.035

EMULSIFIED ASPHALT — For penetration and surface treatment, per gal.:

Boston, applied	$0.12
Cincinnati, f.o.b. refinery	.06
Los Angeles, applied	.11
Des Moines, applied	.12
New York, applied	.15
Philadelphia, applied	.13
Pittsburgh f.o.b. refinery	.04@.06
St. Louis, applied	.12
Seattle, f.o.b. refinery	.055@.085

Iron and Steel

	Pittsburgh	Chicago	Birmingham	Cleveland
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.60	$1.70	$1.75	$1.78
CONCRETE REINFORCING BARS, ¼ in., billet, per 100 lb., carload lots	1.60	1.65	1.75	1.50
SHEETS, per 100 lb., carload lots:				
Hot-rolled No. 10	1.55	1.65	1.85	.....
Hot-rolled annealed No. 24	2.15	2.30	2.35	.....
Galvanized No. 24	2.80	2.95	3.00	.....
TERNE PLATES, per package, I.C., 8-lb. coating, 20x28 in.	9.50	.....	.....	.....
RIVETS per 100 lb., ½ in., structural, carload lots	2.25	2.35	2.70	2.25
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....	.....
WIRE NAILS, per 100 lb., base, carload lots	1.95	2.00	2.40	1.95
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	9.75	6.75	7@7.50	7.00

TRIANGLE MESH—Plain, per 100 sq.ft., 4 in. x 4 in., in carload lots:

Style Number	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	22	$0.94	$0.96
049	28	1.19	1.22
068	35	1.45	1.49
093	45	1.87	1.91
126	57	2.31	2.37
153	68	2.75	2.82
180	78	3.16	3.24
245	103	4.17	4.27
287	119	4.82	4.94
33X	138	5.59	5.73
395	160	6.48	6.64
036P	17	.71	.73
053P	24	1.01	1.03

TRIANGLE MESH—*Continued.*:

Style Number	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
072P	31	1.27	1.30
097P	40	1.64	1.68
049R	24	1.01	1.03
067R	31	1.27	1.30
089R	40	1.64	1.68

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½ %
Galvanized steel rigging and guy rope	12½ %
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½ %

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd., painted, f.o.b., in carload lots 2.2 lb. per sq.yd., standard-mesh diamond lath:

Atlanta	$20.00*	Los Angeles	$17.00
Birmingham	17.00	New Orleans	20.50
Boston	15.00	New York	13.50
Chicago	10.60	Philadelphia	13.50
Cincinnati	11.00	Pittsburgh	13.50
Dallas	18.00	St. Louis	15.50*
Detroit	18.00*	San Francisco	17.00*
Kansas City	17.00*	Seattle	19.00

*Delivered.

STEEL FREIGHT RATES — Per 100 lb., effective Dec. 3, 1931, on finished steel products in the Pittsburgh District, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.; 40,000 lb. per car:

Atlanta, 36,000 lb	$0.60	Detroit	$0.285
Baltimore	.29	Kansas City	.59
Birmingham	.60	New Orleans, 36,000 lb	.69
Boston	.42	New York, 40,000 lb	.35
Buffalo	.255	Pacific Coast, 60,000 lb	1.17*
Chicago	.36	Philadelphia	.31
Cincinnati	.285	St. Louis	.41
Cleveland	.205	St. Paul	.60
Denver	.92	* All rail.	

Railway Materials and Supplies

STEEL RAILS — Per gross ton, f.o.b.

	Pittsburgh	Birmingham	Chicago
Standard rails	$40.00	$40.00	$40.00
Light rails	32.00	32.00	34.00
Re-rolled rails	21@23	.....	27.00

RAILWAY TIES — Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$1.00	.....
	Pine, untreated	.90	.....
	Pine, creosoted	1.40	.....
New York	Long-leaf sap pine, untreated	.90	$1.10
	Dense yellow pine, untreated	.65	.85
Birmingham	White oak, untreated	.75	.95
	White oak, creosoted	1.35	1.45
	Southern pine, untreated	.35	.80
	Southern pine, creosoted	.95	1.35
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
Los Angeles	Fir, untreated	.47	....
	Fir, creosoted	1.20	....
Philadelphia	Red oak, untreated	.95	1.15
	Red oak, creosoted	1.47	1.90
St. Louis	White oak, untreated	.75	1.25
	Red oak, untreated	.70	1.05
	Red oak, creosoted	1.05	1.65
	Sap pine or cypress, untreated	.60	1.00
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f.o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Angle bars	$2.75	$2.75	$2.75
Standard spikes	2.60	2.60	2.60
Tie plates	1.85	1.85	1.85
Track bolts	3.50	3.50	3.50

Pipe

WROUGHT STEEL PIPE — Discounts from standard list for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Boston	55.5%	42.25%	51.35%	40.1%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
Denver	44.5%	32%	41%	28.5%
New York	56.14%	43.6%	52.72%	40.18%
Philadelphia	57.28%	44.68%	53.68%	41.80%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	51%	38%	48%	35%

Current Prices of Construction Materials

Pipe—Continued

CAST-IRON PIPE— Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots; gas pipe and Class A, $3.00 per ton extra:

	4-In.	6-In. and Over
Atlanta	$37.50	$34.50
Boston	39.00	36.00
Birmingham (Base)	33.00	30.00
Burlington (Base)	33.00	30.00
Chicago	41.50	38.50
Dallas	45.50	42.50
Los Angeles	41.50	38.50
New York	36.50	33.50
Philadelphia	33.00	30.00
Pittsburgh	39.50	36.50
St. Louis	40.50	37.50
San Francisco	41.50	38.50

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.125	$0.21	$0.385	.....	$1.40	.....	.....
Baltimore	.10	.30	.58	.....	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.16	.25	.50	1.25	2.10	4.40	5.50
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.0945	.....	.2835	.....	1.125	2.448	.....
Cleveland	.135	.21	.405	1.125	2.025	4.824	7.38
Dallas	.23	.....	.7165	.....	2.70	.....	.....
Denver	.16	.23	.414	.816	1.44	.....	.....
Detroit	.0855	.....	.2625	.....	1.90	3.80	.....
Kansas City	.21	.335	.52	1.00	1.90	3.80	.....
Los Angeles(f.o.b.)	.2175	.2825	.5085	1.1865	2.034	3.69	.....
Minneapolis	.18	.23	.46	1.20	1.85	3.20	4.26
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.18	.30	.54	1.02	1.95	.....	.....
New York	.13	.21	.42	1.15	2.10	.....	.....
Philadelphia	.081	.126	.243	.65	1.17	2.376	4.615
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.112	.210	.378	.945	1.62	3.20	4.40
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.21	.30	.54	1.26	2.16	3.60	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Atlanta	$50.00	Los Angeles	$60.00
Birmingham	50.00	New Orleans	40.00
Boston	40.00	New York	35.00
Chicago	40.00	Philadelphia	36.00
Dallas	65.00	Pittsburgh	60.00
Denver	75.00	St. Louis	40.00
Detroit	40.00	San Francisco	67.50
Kansas City	70.00	Seattle	42.50

Miscellaneous

LINSEED OIL—Raw, in 5-bbl. lots, per lb., f.o.b.:

Atlanta	$0.075	Minneapolis	$0.073
Birmingham	.066	Montreal (per gal.)	.50
Boston (per gal.)	.50	New York	.071
Dallas (per gal.)	.555	Philadelphia	.064
Denver (per gal.)	.64	Seattle	.075
Kansas City (per gal.)	.51	St Louis	.077
Los Angeles	.0813	San Francisco (del)	.1125

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Atlanta	$12.50	Montreal	$ 8.20
Birmingham	12.50	New Orleans	11.00
Boston	11.50	New York	12.00
Dallas	13.00	Philadelphia	9.50
Kansas City	12.50	Seattle	11.00
Los Angeles	11.50	St. Louis	12.00

Note: Both white and red lead, dry, same prices as foregoing; red in oil, $1.50 higher.

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75
Calcium chloride, 77-80%, flaked, in 400-lb. drums, f.o.b. works, per ton	21.00
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in bags, per 100 lb.	1.17½
Sulphate of aluminum, in bags, per 100 lb.	1.25
Sulphate of copper, in bbl., per 100 lb.	3.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¼-in., 6-ft.; ½-in., 1½-ft.; ¾-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft., 8-in. Following prices are per lb. for ¼-in. and larger, delivered in 1,200 ft. coils:

Atlanta	$0.18	Kansas City	$0.21
Baltimore	.225	Los Angeles	.1725
Birmingham	.20	Minneapolis	.175
Boston	.16	Montreal	.1625
Chicago	.175	New Orleans	.185
Cincinnati (f.o.b.)	.21	New York	.165
Cleveland	.21	Philadelphia	.15
Dallas	.18	St. Louis	.155
Denver	.18	San Francisco	.155
Detroit	.18	Seattle	.155

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point $2.40

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.65

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Atlanta	$5.85	$6.25	$2.05
Boston	6.25	6.00	2.50
Dallas	4.50	3.66	1.90
Detroit	6.25	6.50	2.00
Montreal	6.40	6.20	2.68
New Orleans	5.60	5.50	2.00
New York	6.50	6.25	2.50
Philadelphia	4.00	3.80	1.45
Seattle	.....	6.60	2.55
St. Louis	5.18	6.24	1.89

*Slate finish, sufficient to cover 100 sq.ft. ‡Slate surfaced, in rolls weighing 85 to 90 lb. †4 in 1, hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch,* per Ton
Atlanta	$44.50†	$44.50†	$0.45	$44.50
Boston	2.40	2.40	0.33	28.00
Dallas	3.17	3.00	.75	38.00
Denver	2.00	2.00	.90	18.00
Montreal	2.62‡	2.02‡	1.40	32.60
New Orleans	.....	2.50	.....	22.50
New York	2.40	2.40	.34‡	28.00
Philadelphia	2.25	2.25	.33	20.00
Seattle	2.40	2.40	.55	27.90

*In 350 lb. barrels. †Per ton. ‡Per roll.

WINDOW GLASS—Discounts from latest jobbers list, dated Sept. 15, 1928 for sizes above first three brackets:

	Single Thickness— A Quality	Single Thickness— B Quality	Double Thickness— A Quality	Double Thickness— B Quality
Atlanta	85%	85%	85%	85%
Birmingham	89%	91%	89%	91%
Boston	88%	90%	87%	89%
Dallas	85%	85%	85%	85%
Denver	84@5%	86@5%	84@5%	86@5%
Kansas City	90@5%	90@5%	90@5%	90@5%
New York	87%	89%	87%	89%
Philadelphia	88%	90%	88%	90%
Pittsburgh	87%	89%	87%	89%
Seattle	90@10%	90@20%	90@10%	90@20%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.215	$0.2375	Los Angeles	$0.145	$0.165
Baltimore	.21	.225	Minneapolis	.18	.195
Birmingham	.13	.1525	Montreal	.1675	.1925
Boston	.225	.25	New Orleans	.195	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati (f.o.b.)	.22	.245	Philadelphia	.215	.24
Dallas	.22	.24	St. Louis	.145	.165
Denver	.19*	.21*	San Francisco	.1575	.1825
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*F.o.b Louviers.

Lumber

LUMBER—Per M. ft., b.m., No. 1, Common, rough, in carload lots:

SOUTHERN L. L. YELLOW PINE

	1 x 6 In.* F.o.b.	1 x 6 In.* Del.	1 x 8 In.* F.o.b.	1 x 8 In.* Del.	3 x 12 In.† F.o.b.	3 x 12 In.† Del.	12 x 12 In.† F.o.b.
Atlanta	$14.00	.....	$15.00	.....	$35.00	.....	$45.00
Baltimore	.....	$46.00	.....	.....	.....	$70.00	70.00
Birmingham	.....	15.00	.....	$15.00	.....	18.00	25.00
Boston	30.00	32.00	29.00	34.00	45.00	50.00	70.00
Chicago	.....	.....	.....	.....	.....	62.50	.....
Cincinnati	.....	28.00	.....	28.00	.....	35.0	35.00
Cleveland	30.00	38.00	32.00	4u. 0	46.00	54.00	.....
Dallas	.....	27.50	.....	27.50	.....	52.50	52.50
Denver	.....	31.00	.....	33.00	.....	45.00	.....
Detroit	30.00	32.00	30.00	32.00	32.00	32.00	45.00
Kansas City	24.00	.....	21.00	.....	46.00	.....	.....
Minneapolis	.....	31.00	.....	31.00	.....	34.00	.....
Montreal	44.00	.....	5.00	.....	30.00	.....	.....
New Orleans	.....	16.00	.....	17.00	.....	50.00	.....
New York	22.50	23.50	23.50	24.50	47.50	59.40	47.50
Phil. No. 2(com.)	19.00	23.00	20.00	24.00	29.00	33.00	44.00
Pittsburgh	20.00	33.00	20.00	33.00	32.00	39.00	46.00
St. Louis	23.50	28.50	23.50	28.50	45.00	50.00	45.00

DOUGLAS FIR

	1 x 6 In.* F.o.b.	1 x 6 In.* Del.	1 x 8 In.* F.o.b.	1 x 8 In.* Del.	3 x 12 In.† F.o.b.	3 x 12 In.† Del.	12 x 12 In.† F.o.b.
Baltimore	.....	$43.00	.....	.....	.....	$46.00	$46.00
Boston	$25.00	30.00	$27.00	$32.00	$31.00	36.00	48.00
Chicago	.....	.....	.....	.....	.....	44.52	.....
Cincinnati	.....	.....	.....	.....	.....	42.50	42.50
Cleveland	30.00	38.00	32.00	40.00	46. 0	54.00	.....
Denver	31.00	.....	33.00	.....	46.00	.....	50.00
Detroit	.....	.....	.....	.....	30.00	30.00	45.00
Kansas City	30.00	.....	33.00	.....	42.00	.....	39.00
Minneapolis	.....	31.00	.....	31.50	.....	36.00	.....
New Orleans	.....	20.00	.....	20.00	.....	42.50	.....
New York	21.50	22.50	22.50	23.50	25.50	26.50	26.50
Philadelphia	.....	.....	.....	.....	.....	28.00	30.00
Pittsburgh	.....	.....	.....	.....	58.00	63.00	48.00
St. Louis	30.50	35.50	30.50	35.50	31.00	36.00	31.00
San Francisco	.....	15.00	.....	16.00	.....	17.00	17.00
Seattle	9.00	11.00	11.00	13.00	12.00	14.00	15.00

*Form lumber, 16 ft. lengths. †Planks and timbers, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442